

A
HISTORY OF HINDU CHEMISTRY

BY
SIR PRAPHULLA CHANDRA RAY, Kt., D. Sc., Ph. D.

VOL. II

Second Edition : Revised and Enlarged

RAMA VARMA RESEARCH INSTITUTE,
TRICHUR, COCHIN STATE.





SELECT OPINIONS ON VOL. I.

I consider that the work is a most interesting and valuable contribution to chemical History; and exhibits an amount of learning and research which does the author the greatest credit.—*Sir Henry E. Roscoe.*

A new and interesting chapter has been added to the history of sciences and of human progress.—*M. Berthelot.*

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That unusually interesting work.—*Pharmaceutical Post, (Vienna)*

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This Pioneer work is a monumental labour of love. *The Englishman.*



HISTORY OF HINDU CHEMISTRY





A
HISTORY OF HINDU CHEMISTRY

FROM

*THE EARLIEST TIMES TO THE MIDDLE OF THE
SIXTEENTH CENTURY A. D.*

WITH

**SANSKRIT TEXTS, VARIANTS, TRANSLATION
AND ILLUSTRATIONS**

BY

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VOL. II

Second Edition : Revised and Enlarged

CHUCKERVERTY, CHATTERJEE & Co., Ltd.

15, College Square, Calcutta.

1925

PUBLISHED BY
R. C. CHAKRAVARTI M.Sc.
15 College Square, Calcutta.



PRINTED BY
P. C. CHAKRAVARTY
VIDYODAYA PRESS
17 Radha Nuth Bose Lane, Calcutta.

RAMA VARMA RESEARCH INSTITUTE,
TRICHUR, COCHIN STATE.

To the Memory of

M. P. E. BERTHELOT

I dedicate this volume of the History
of Hindu Chemistry.



PREFACE

The second and concluding volume of the *History of Hindu Chemistry* is now presented to the public.

When the first volume was under preparation, it was feared that many valuable works on Hindu Chemistry referred to in *Rasārṇava*, *Rasaratna-samuchchaya*, etc., had been lost for ever. Pandit Navakānta Kavibhūṣaṇa was deputed to Benares to make a searching enquiry and his labours have been rewarded by the discovery of several rare MSS., including one of *Rasabhidhaya*. This last-named work is of surpassing interest considering its comprehensiveness and antiquity. Two more transcripts of it have also been procured from the Libraries of the India Office, London, and of the Darbār, Nepal. A copy of *Rasendra-chūdāmāni* obtained from the Library of the Deccan College, Poona, has also been of signal help. A critical study of the new materials throws a flood of light on the dark recesses of the history of Indian Chemistry. As a halo of literary and scientific activity including the pursuit of alchemy circles round the prominent figure of Nāgārjuna, considerable space has been devoted to a discussion of his age in the Historical Introduction.

It was with diffidence and hesitation that I placed the remotest limit of alchemical *Tantras* in the 12th century A. D. It now transpires that this date is to be pushed back by several centuries.

A *History of Hindu Chemistry* would be rightly regarded as incomplete which did not deal with the constitution of matter and the various hypotheses in regard to it. The European historian of chemistry has always turned his eyes to Greece as the perennial fountain of knowledge on this as on other subjects. And it is but natural that he should do so. * The Hindu atomistic school has not hitherto, I am afraid, found an interpreter who could do full justice to it. Colebrooke's presentation of it with which I had to content myself in the first volume is masterly so far as it goes, but is fragmentary. Not feeling myself equal to the task I applied for help to Mr. Brajendra Nath Seal Principal, Victoria College, Cooch Behar. Principal Seal has kindly responded to my appeal with alacrity. It is to be hoped that a long-felt *desideratum* has at last been supplied.

The frequent references which have been made to the first volume must be taken to mean the second edition of it. Those who happen to possess copies of the first edition will not, however, be put to any serious inconvenience.

I avail myself of this opportunity to express my cordial thanks to Pandit Harischandra Kaviratna late Professor of Sanskrit, Presidency College, and my collaborator in the editing of the text of Rasārnava in the *Bibliotheca Indica* series.

In the preface to the first volume I presumed to narrate the circumstances under which I undertook the composition of my History. The great chemist and savant, whose inspiration has been my guiding principle throughout the arduous task and whose lengthy and appreciative review of the first instalment has been a stimulus in the continuation of it is no more. Marcellin Berthelot breathed his last on March 18, 1907, leaving the world of science poor indeed. It was with the view of coming into personal contact with the illustrious scientist that the author made a pilgrimage to Paris in March, 1905. The long interview which he had with M. Berthelot and the reception which was accorded to him at a meeting of the Academy of Sciences by its late Perpetual Secretary, as also by its President M. Troost, made a deep and lasting impression on his mind.

Alas, for the vanity of human wishes ! These pages will no longer be greeted by the eager and indulgent eyes of M. Berthelot. All that now remains for me is to dedicate this volume to his sacred memory.

It is with mingled feelings that I mark the hour of my final deliverance from a self-imposed task which has occupied all my spare time during the last 15 years and more—feelings not unlike those which overpowered the Historian of the Roman Empire. The reader will, I hope, forgive me if I venture to give expression to them in the words of Edmund Gibbon himself, "I will not dissemble the first emotions of joy on the recovery of my freedom. * * * But my pride was soon humbled, and a sober melancholy was spread over my mind, by the idea that I had taken an everlasting leave of an old and agreeable companion."

The Hindu nation with its glorious past and vast latent potentialities may yet look forward to a still more glorious future, and, if the perusal of these pages will have the effect of stimulating my countrymen to strive for regaining their old position in the intellectual hierarchy of nations, I shall not have laboured in vain.

PRESIDENCY COLLEGE

P. C. RAY.

June 1, 1909.

PRELIMINARY REMARKS ON THE
MECHANICAL, PHYSICAL AND
CHEMICAL THEORIES OF
THE ANCIENT HINDUS.

My paper on the *Mechanical, Physical and Chemical Theories of the Ancient Hindus* is intended to be a synoptic view of the entire field of Hindu Physico-chemical Science, so far as this reached the stage of positive Science as distinguished from the prior mythological and empirical stages. As the work in which my paper appears relates to Hindu Chemistry, I have elaborated the chemical portions, including the Hindu account of the constitution of the fats and oils and the organic tissues in addition to Hindu inorganic chemistry. I have also briefly noticed the chief chemical industries of the Hindus which secured them an easy pre-eminence in manufactures for a thousand years, and, in the *Addenda*, given some interesting recipes relating to several matters of chemical technology. Of mechanico-physical theories, I have expounded the Hindu conception of Energy, potential as well as kinetic, and of molecular motion, so far as they are applied to the elucidation of problems of a physico-chemical nature, viz., the constitution of

matter, the genesis of atoms and their infra-atomic constituents, and the chain of mechanical causation in the system of Nature. I have also touched on the Hindu theories of light, heat and sound, as implying current or wave motion, leaving the elaborate exposition to my paper on Hindu Mechanics and Physics. In the *Appendix*, I have added a brief account of the Scientific Method of the Hindus, which shows that all this was not a mass of unverified and unverifiable speculation (the very antipodes of science).—the charge usually brought against Hindu thought and culture,—but professed to be the outcome of a Scientific Methodology which, in its formulation of the canons of the two fundamental Inductive Methods, is more comprehensive as well as more original and suggestive than Mill, and which, as regards its Applied Logic of the Sciences, (*e.g.* the Logic of Therapeutics, of Grammar *etc.*), is a standing testimony to the systematic completeness and rigour of the Hindu scientific mind. The difficulties of my task have been formidable, but I have not written one line which is not supported by the clearest and most authoritative texts. The ground trodden is, for the most part, absolutely new. I have gone back to the *origines*, and studied the authorities at first hand, being resolved to eschew all second-hand sources of information. Fortunately the Sanskrit philosophico scientific terminology,

however difficult from its technical character, is exceedingly precise, consistent and expressive. The materials also are full and the sources of information corroborate one another. Another difficulty I have sought to guard myself against is the unscientific, unhistorical but very common and almost inevitable habit of reading modern ideas into old guesses or speculations of a happy-go-lucky or nebulous character. I do not think that the mere passion for Truth is a sufficient safeguard against this fatal facility of unconscious distortion or misrepresentation. A true historical perspective can only be acquired by historico-comparative studies, with the application of the correct historico-comparative method (vide the Introduction to my Comparative Studies in Vaishnavism and Christianity). I have also practised, or tried to practise, a habitual understatement, without consciously falling into that '*suppressio veri*' which is so often a '*suggestio falsi*.' How far I have succeeded in exhibiting the truth about Hindu sciences or the Hindu scientific mind is a question which I leave to competent judges to answer.

Before concluding, I must advert to my use of the terms "isomeric" and "polymeric" in senses different from the current ones, though suggested by the principle of analogous extension. Instead of coining new terms, I adopted (perhaps with a questionable freedom) these existing ones to ex-

press the Hindu idea of distinctions of chemical substances due merely to difference in spatial position or arrangement among the particles, without any implications whatever as to percentage composition or molecular weight. A study of the original sources has made it clear to me that a "Bhūta" in Hindu Chemistry represents a class of elements composed of similar atoms, and the different elementary substances comprised under one and the same "Bhūta" are 'isomers', in this limited sense, in reference to the atoms, being specifically constituted by differences of spatial position and arrangement among the latter. This is true of the Sāṅkhya-Pātañjala and the Nyāya-Vaiśeṣika alike. But in the Sāṅkhya-Pātañjala, the atoms themselves are composed of Tanmātras; and in one view, the atoms that enter into the "isomeric" modes of the same "Bhūta" are themselves "stereo-isomers" in reference to the Tanmātras. A tri-Tanmātric atom, for example may have different isomeric forms which would account for the divers modes of the "Bhūta" originating with this class of atoms. Hence under the Sāṅkhya Pātañjala, I speak of "isomeric" atoms, while under the Nyāya-Vaiśeṣika I confine myself to the phrase "isomeric modes of the same Bhūta". It appears to me also that in the Sāṅkhya-Pātañjala view, while an atom of a particular kind (say a tri-Tanmātric or a tetra-Tanmātric one) may have "isomeric" forms of its own, the

atoms of the different "Bhūta" classes (from the mono-Tanmātrīc to the penta-Tanmātrīc) are what may in a broad sense be termed polymers of the A'kāśa Tanmātra and Bhūtādi (matter-radiment). Under the Sāṅkhya-Pātanjala, therefore, I have spoken of "polymeric" atoms and "polymeric" combinations of these, though I must confess that I have done so with great diffidence and hesitation.

VICTORIA COLLEGE,
COOCH BEHAR.
23rd May. 1909.

B. N. SEAL.



CONTENTS

INTRODUCTION

CHAPTER I

ON THE AGE OF NAGÁRJUNA AND BUDDHIST ALCHEMICAL TANTRAS

Rise, Development and Propagation of Maha'ya'nism—
Nagá'rjuna: a Leading Representative of Maha'ya'nism—
Nagá'rjuna as an Adept in Magic and Alchemy—Nagá'r-
juna as a Contemporary and Friend of King Sadva'hana—
Nagá'rjuna as a Comprehensive Name of the Activity of
Maha'ya'nism—Asanga—Gradual and Imperceptible Fusion
of Maha'ya'nism with Saivism—Dharmis as the Precursors
of the Tantras—Vaipulya Sūtras—Buddhist Tantras—
Tantras imported into Tibet—Rasaratna'kara—Its Historical
Importance—Also a Typical Production of the Maha'ya'nist
Period of Intellectual Activity—Antiquity of Alchemical
Tantras—Alchemy an Integral Part of Maha'ya'nist Activity
—Spread of Alchemy—In Tibet and the Deccan ... i-xlix

CHAPTER II

Further Cultivation of Alchemy—Buddhist Alchemical
Tantras absorbed into Hindu Tantras—Rasahrīdaya—
Rasendrabhū'ḍa'maṣi—Rasaprakā'sandha'kara—Rasakalpa-
Rasara'jalakṣmī l-lix

CHAPTER III

(*Circa 1350 A. D.*)

Rasaratna'kara by Nityana'tha—Rasendrabhū'ḍa'maṣi—
Rasara'ra—Sa'rngadhara-saṃgraha—Rasendrasa'rasaṃgraha—
Rasendrakalpadruma—Dhāturaṇa'ma'la' ... lxi-lxxv

CHAPTER IV

Modern Period (1500-1600 A.D.)

Rasadīpa—Rasakaumudī—Bha'vaprakā'sa—Arhaprakā'sa
lxxvi-lxxvii

CHAPTER V

Indigenous Origin of Indian Alchemy

lxxxiii-xciii

CHAPTER VI

Some Noted Indian Alchemists and Their Works

xciv-xcvi

THE TANTRIC PERIOD

(Continued from Vol. I.)

Chemistry in Rasaratna'kara of Na'ga'rjuna 1-9

Chemistry in Rasahridaya of Bhikshu

Govinda 9-12

Chemistry in Ka'kachandesvari'mata

'Tantra 12-13

Chemistry in Rasendrachu'da'mani of

Somadeva 14-16

Chemistry in Rasaprakā'sa-sudha'kara of

Yasodhara 16-18

Chemistry in Rasachintamani of Mada-

na'nta Deva 18-19

Chemistry in Rasakalpa (Rudraya'mala

Tantra) 19-22

CONTENTS

Chemistry in Rasara'jalakshmi' of Vishnudeva	22
Chemistry in Rasanakshatrama'lika' of Mathanasimha, Physician to the King of Malwa	22-23
Chemistry in Rasaratna'kara of Nitya- na'tha	23
Chemistry in Dha'turatnama'la'	23
Chemistry in Rasapradīpa	24
Chemistry in Dha'tukriya' or Dha'tu- man'jari' (Rudraya'mala Tantra)	24-27
Chemistry in Suvarnatānta or Svārna- tānta	28-29
Knowledge of Gems	
Relative weight—Hardness—Lustre, Transparency, Colour and other Optical Properties—Fusibility—General and Concluding Remarks	30-41
Note on the Method of Preparing Caustic Alkali	42-43
The Tantrists, the Rosicrucians and the Seekers after Truth	44-49
The Metals and their Loss in Weight after Calcination	51-53
Antimony	54
The Preparation known as Svārna- sindura or Makaradhvaja	55-57
Identification of Metals by their Coloura- tion of Flames	57
The Age of Bhikshu Govinda, the Author of Rasahrīdaya	57-58

THE MECHANICAL, PHYSICAL AND CHEMICAL THEORIES OF THE ANCIENT HINDUS.

(By Principal B. N. SEAL)

The Sa'nkhya-Pa'tanjala System

Prakṛiti, the Ultimate Ground—The Original Constituents and their Interaction—The Starting Point—Beginning of Evolution—Formation of Wholes or Systems—Collocation of Reals—The Formula of Evolution—The Conservation of Energy (and of Mass)—The Transformation of Energy—The Doctrine of Causation a Corollary from the Conservation and Transformation of Energy—The Principle of Collocation—The Storing-up and the Liberation of Energy—Chain of Causation—Fixed Order—Time, Space and the Causal Series—Space as Extension and Space as Position—The Causal Series—The Dissipation of Energy (and of Mass)—Their Dissolution into the Formless Prakṛiti—The Evolution of Matter—the Genesis of the Infra-atomic Unit-potentials and of the Atoms—Cosmo-genesis, a Bird's-eye View—Chemical Analysis and Synthesis—Elements and Compounds 59-124

Chemistry in the Medical Schools of Ancient India

Physical Characters of the Bhūtas—The Maha'-Bhūtas—Mechanical Mixtures—Qualities of Compounds—The extant Charaka and Susruta—Succession of Medical Authorities—Preparation of Chemical Compounds—Chemical Compositions and Decompositions—Organic Compounds—Poisons—Fetal Development (after Susruta)—Chemistry of Digestion—Formation of Molecular Qualities in Chemical Compounds—Chemistry of Colours—Pariva'na-va'da 1.3908
A'rambha-va'da 124—158

Weights and Measures

Measures of Time and Space—Bha'skara'cha'ryya, a Precursor of Newton in the Conception of the Differential Calculus and its Application to Astronomy—Measures of Weight and Capacity—Size of the Minimum Visible (Atom) 158-168

Vedantic System

Máyá—Evolution of Different Forms of Matter—Panch-karana 168-176

The Atomic Theory of the Buddhists 177-178

The Atomic Theory of the Jains

General Properties of Matter—Atomic Linking 178-185

The Nyáya-Vaiśeṣika Chemical Theory

Theory of Atomic Combination—Chemical Combination—Mono-Bhautic Compounds—Hetero-Bhautic Compounds—The Theory of Dynamic Contact (Viśiṣṭambha)—Oils, Fats, Milks—Mixtures like Soups, Solutions, etc.—Chemical Action and Heat—Light Rays—Theory of Reflection, Refraction etc.—Arrangement of Atoms in Space—The Foundations of Solid Co-ordinate Geometry—Three Axes of Va'chस्पति—Graphic Representation of the Constitution of a Bi-Bhautic Compound (with "complex contact") 185-215

Conception of Molecular Motion (Parispaṇḍa)

Parispaṇḍa—Gati-Santa'na—Current and Wave Motion—Vibrations and Waves of Water—Sound-Waves—Different Views of their Nature—Rays of Light 215-221

The Date of Rasaratnasamuchchaya 222-223

The Weight of Air (By Principal B. N. Seal)

223-224

APPENDIX

THE HINDU DOCTRINE OF SCIENTIFIC METHOD

Doctrine of Scientific Method—Test of Truth—Perception—Observation and Experiment—Results in the Different Sciences—Fallacies of Observation—Doctrine of Inference—The Cha'ren'ka View—The Buddhists, their Analysis and Vindication of Inference—Causality and Identity of Essence—How to ascertain Concomitance—Specific Cause and Specific Effect—Canon of the Method of Subtraction—The Joint Method of Difference (Panchaka'rani)—Proof of the Method—Doubt and its limits—The Nyā'ya Doctrine of Inference—Definition of a Cause—Unconditional Antecedent—The Doctrine of Anyathā'siddha—Elimination of the Irrelevant Factors—Nyā'ya objection to the Method of Difference—The Nyā'ya analysis of the Causal Relation Continued—Co-effects—Synchronousness of Causes and Effects—Plurality of Causes—The Nyā'ya ground of Inference—Vya'pti or Unconditional Concomitance—Ascertainment of Vya'pti—Upā'dhi—Process of disproving suspected Upā'dhis—Tarka or Uha—Difference between the Nyā'ya Method and Mill's Joint Method of Agreement—Other Instances of Vya'pti—Relation of Causality to Vya'pti—Plurality of Causes—Scientific Methods as subsidiary to General Methodology and the Ascertainment of Truth—Hypotheses—Conditions of a Legitimate Hypothesis—Nirnaya or Verification of a Hypothesis—The Deduction Method—Nā'ya Nyā'ya and its Significance in the History of Thought—Applied Logic—The Logic of the Particular Sciences—The Scientific Methods as applied to Therapeutics—The Scientific Methods as applied to Grammar and Philology—Conclusion

ADDENDA

EMPIRICAL RECIPES OF CHEMICAL TECHNOLOGY

Searing of Rocks—Hardening of Steel—Preparation of Cements—Nourishment of Plants	285-290
---	---------

ERRATA

SANSKRIT TEXTS

Extracts from Rasaratna'kara	3-17
Extracts from Rasahrīdaya	18-41
Extracts from Ka'kachandesvari'mata Tantra	42-50
Extracts from Rasendracū'da'mani	51-56
Extracts from Rasapraka'sasudha'kara	57-67
Extracts from Rasachinta'mani	68-71
Extracts from Rasakalpa	72-79
Extracts from Rasara'jalakshmi	79-82
Extracts from Rasanakshatrama'lika'	82-83
Extracts from Rasaratna'kara	84-86
Extracts from Dha'turatnama'la'	86-89
Extracts from Rasapradī'pa	90-94
Extracts from Dha'tukriya' or Dha'tu- manjari	95-146
Extracts from Suvarnatāntra or Svarnatāntra	147-152

INDEX

Index of Proper Names

Index of Subjects



Introduction

CHAPTER I

On the age of Nāgārjuna and the Buddhist Alchemical Tantras.

IN the first Volume it has been incidentally mentioned that side by side with the Sivaite Tantras we have their Buddhist counterparts in which the salient features of the former appear.* The question now arises: when did the votaries of the religion of Śākyamuni find themselves called upon to engraft upon their simple and pure creed the *ensemble* of the gross and grotesque superstitions, the hideous incantations, as also the speculative, the metaphysical and esoteric phases of spiritual aspirations of which the Tantras are the repositories? The answer cannot be given off-hand

Rise, development
and propagation of
Mahāyānism.

* Vol. I, Intro. lxx.

in a few words, for it will lead us to a discussion of the origin and development of Maháyánism. Under ordinary circumstances we should have considered it beside our purpose to devote much space to this subject in a work dealing with the history of chemistry. But it so happens that the most prominent figure in Indian alchemy, who is acknowledged on all hands to be the discoverer of the processes of distillation, sublimation etc., is no other than the reputed founder of the Mádhyamika system of philosophy, the renowned Nágárjuna. A brief and rapid survey of the causes which led to the origin of Maháyánism and its intimate connection with the tenets of the Sivaite cult will be of help to us.

It is one of the saddest episodes in the history of the great religions of the world that the purity of life, right conduct, right living—in short, the moral code upon which their founders have always laid particular stress, soon begin to occupy a subordinate position and a dogmatic theology springs up in time, which gives occupation to the subtlest intellect.

As for the masses of the people it is doubtful if ever they have remained contented with the mere ethical aspect of a religion. At any rate we find that immediately after the tidings of the death of Buddha had spread about there was a squabble among his followers for the possession of the master's corporeal relics and in course of time stūpas were raised over them, which no less than the three jewels (*Ratnatraya*)—the Buddha, the Dharma and the Sangha,—and the Bodhi-tree became objects of worship of the devotee. The Chaityas, Vihāras and other sanctuaries of divers sorts, with which Buddhist India was dotted over in the first and second centuries after the decease of the great teacher, afforded asylums for a vast multitude of monks, who, freed from all worldly cares, found ample leisure to formulate and draw up a code of spiritual and disciplinary exercises.

Although their high ideal was "to lead sweet lives of purest chastity" and induce their lay brethren to follow in their footsteps, rituals and ceremonials of an imposing and

elaborate character soon obscured the ray of light which shone forth from the founder. Thus we find that within 150 years after the passing away of Buddha tedious and circumstantial regulations as to the quality of robes to be worn by the Bhikshus, the mode of bathing and fasting, the taking of the midday meal, the drinking of unchurned milk, probation and penance, dwellings and furniture and so forth were amongst the weighty subjects for discussion in the Second General Council.* We need not pursue the subject further. The reader who is interested in the study of comparative religions will find striking parallels in the early history of the Christian Church.†

* "On the daily Life of the Bhikshus". *Vinaya Texts* (S. B. E. Series). The Chullavagga, Pt. iii, p. 66.

† The Sermon on the Mount was more or less forgotten. Idolatry disappeared, it is true, but only to re-appear in the shape of Mariolatry and the worship of Saints and relics. In the heat of the schismatic strifes, Christian Charity had to make shift for itself as best as it could. Theologians were busy with the interpretation of the writings of the fathers. In a word, the dogmatic to a large extent superseded the moral element of religion.

We are not concerned here with tracing the rise, progress or decline of Buddhism ; if we have at all referred to its excrescences, it is only to prepare the mind of the reader for the proper understanding of the Maháyánist development.

The India of Asoka and of the fourth and third centuries B. C. was in the main Buddhist, but it should not for a moment be supposed that the old faith was extinct. The triumph and ascendancy of the teachings of Sákya-muni and his followers were due in a large measure to the fact that they drew upon, and incorporated into, their creed much that was essentially of Hindu origin.* As Dr. Bhāṇḍārkar observes :—

* Prof. Rhys Davids expresses the same views in several places :—"There is ample evidence even in the books of the orthodox body of Brahman teachers to show that when Buddhism arose there was not only much discussion of the ultimate problems of life, and a keen interest in the result but also that there was a quite unusually open field for all sorts of speculations".—"Buddhism," *American Lectures on the History of Religions* (1896), p. 26. Again: "But Buddhism is essentially an Indian system. The Buddha himself was,

"But it was not the metaphysical doctrines of Buddhism that influenced the masses of the people. What proved attractive was its ethical side. The Buddhist preachers discoursed on Dharma or righteousness to the people. Such discourses on Dharma without the introduction of any theistic idea have their representatives in the Brahmanic literature. In many of the episodes of the Mahābhārata especially in the Śānti and Anuśāsanika books we have

throughout his career, a characteristic Indian. he was the greatest and wisest and best of Hindus."—*ibid.*, p. 117. The same high authority puts it more tersely when he says: "This is partly, no doubt, because we call them Buddhists, and imagine them, therefore, to belong to a separate class, quite distinct from other Indians of that stock. The Buddhists were, as a matter of fact, characteristically and distinctly Indian."—"Buddhist India," p. 165. Cf. "Buddhism, in fact, may be regarded as a reformed phase of Hindu religion and ethical activity. The Buddhist doctrine of the vanity of the world had been thoroughly disseminated by Yājñavalkya (in the Śatapatha Brāhmaṇa) and with it the practice of subsistence upon alms as Pravrajaka or Bhikṣu; and a fruitful soil had thereby been prepared for Buddhism". Weber's "Hist. Sans. Lit." trans. 3rd Ed. (1893) p. 285. Again "This teaching contains, in itself, absolutely nothing new; on the contrary, it is essentially identical with the corresponding Brahminical doctrine; only the fashion in which Buddha proclaimed and disseminated it was something altogether novel and unwonted."—*ibid.*, p. 289.

simply ethical discourses without any reference to 'God, of the nature of those we find in the Buddhistic works ; and sometimes the verses in the Mahābhārata are the same as those occurring in the latter. There appears to be at one time a period in which the thoughts of the Hindus were directed to the delineation of the right conduct in itself without any theistic learning. And Buddhism on its ethical scale represents that phase. Right conduct is the last of the four noble truths of Buddhism."

* * * * *

"It was this phase of Buddhism that with the strenuous efforts of the missionaries and of the Emperor Asoka enables it to achieve success amongst the masses of the people ; and what was wanting on the theistic side was supplied by the perfection and marvellous powers attributed to the founder of the religion. Without this faith in the perfection or, what we should call the divine nature of Buddha, a mere ethical religion would probably not have succeeded. Buddhism was not a social revolution as has been thought by some writers. It was a religion established and propagated by persons who had renounced the world and professed not to care for it. From times of old there existed in the Indian community such persons who were

called *Śramanas* and belonged originally to all castes. These gave themselves to contemplation and sometimes propounded doctrines of salvation not in harmony with the prevalent creed. Buddhism was not even a revolt against caste, for though men from all castes were admitted to the monastic order, and though in the discourses of Buddha himself and others the distinction of caste is pronounced to be entirely worthless, still the object of those who elaborated the system was not to level caste distinctions. They even left the domestic ceremonies of their followers to be performed according to the Vedic ritual. This is one of the arguments brought against Buddhism by Udayanāchārya. "There does not exist", he says, "a sect, the followers of which does not perform the Vedic rites beginning with *Garbhādāna* and ending with the funeral, even though they regard them as having relative or tentative truth."^{*} Buddhism, however, was a revolt against the sacrificial system and denied the authority of the Vedas as calculated to point out the path to salvation. And

**दास्येन तद्वर्ग्यं* यस्य चाङ्गत्वेन हि सुकृतापि नमोऽयानाद्यन्तेऽप्यर्चनं वेदिकीं क्रियां कर्त्तुं शक्नुमिषति । *Ātmatattvavivēka*, Calc. Ed. of Samvat 1908, p. 19. *सङ्गति* relating to *सङ्गति* a Buddhist technical term.

this is the root of the hostility between itself and Brahmanism."*

The zealous missionaries of Buddhism captured the heart of the masses by appealing to their more instincts. Persuasion and not persecution was the instrument they chose to wield. King Asoka proclaimed universal toleration; he inculcated respect for Brahmins as well as *Sramanas* or ascetics of all sects. It is a relief to find that the mighty monarch had never recourse to brute force for the propagation of his creed. We are spared all the scenes of blood, rapine and violence, which disfigure the pages of religious history in the West.

It has already been pointed out that Buddhism itself may be looked upon as an offspring of Hinduism; nay, it is a logical outcome of the principles enunciated in the

* "A peep into the Early History of India from the foundation of the Maurya Dynasty to the fall of the Imperial Gupta Dynasty" (B.C. 322—Circa 600 A. D.) pp. 362-363.

Journal of the Bombay branch of the Royal Asiatic Society (1900), Vol. xx. No. LVI.

Sāṃkhya system of philosophy. If India so readily responded to the teachings of the new faith, it is not because she renounced Hinduism but because she found that all that was highest and noblest in the latter was absorbed in the former. The great Teacher who now arose gave only a new shape and direction and a vigorous impetus to the germ of ideas already in existence and turned them to capital account. A good deal of confusion may be avoided by bearing in mind this aspect of the question. When speaking of Buddhist India one is apt to rush to the conclusion that every vestige of Hinduism had disappeared off the face of the vast continent. As a matter of fact even during the zenith of Buddhistic glory Brahminism was rearing its head and was professed by not a few among the cultured and intellectual classes and was ready to assert itself whenever a favourable occasion arose.

In the second century B. C., we find the Kábul valley, the Punjab and Málava ac-

knowledging the sway of the Princes of the Turkish race.* Wema Kadiphses, the second of the Kushana Dynasty is spoken of as a devotee of Mahesvara; his coins bear the emblem of Nandin on the reverse, which is accompanied by a human figure which holds a trident in its right arm representing Śiva. † The last three Kushanas—Kanishka, Huvishka and Vāsudeva—have been noticed in the *Rājatarāṅginī*,‡ and the emblems on the reverse of their coins are figures of deities borrowed from the Greek, Persian and Brahminical pantheon and of Buddha. Thus the Gods of all these four religions shared the adoration of these Turkish Kings. But the figure of Buddha in the

* Lassen "Indische Alterthumskunde," Vol. ii, pp. 811-13 Ed. 1874.

† *Ibid.* pp. 808-811.

‡ See next page. Regarding the reliability of the account in the *Rājatarāṅginī*, Dr. Stein observes :—"Kalhana's account of the reign of these kings, who are supposed to have ruled simultaneously, is brief enough, but undoubtedly preserves data of genuine historical tradition. It clearly describes them as princes of Turuska, i. e., Turkish nationality, as powerful sovereigns and as faithful patrons of the Buddhist Church. On these points the statements of

sitting or meditative and the standing posture is to be found on the coins of Kanishka alone.*

In the Buddhist ecclesiastical history Kanishka occupies a prominent place. It was in his reign and under his patronage that the Third Council was held to settle the canon once again. The church was convulsed by internal dissensions and schisms, resulting in its being split up into as many as 18 sects. "The most significant trait of the Third Council is that it closed a period of old quarrels between the sects ; it did not prevent the rise of new aspirations. Maháyánism, which in an incipient stage was already existing ere long, boldly raised its head."†

the Chronicle are fully supported by the evidence of our most authentic records. The continued existence of the three places, Kanishkapura, Hushkapura, and Jushkapura, which are described as foundations of these kings and which still survive to the present day is likely to have assisted in preserving a recollection of their founders."

* Percy Gardner : "Coins of Greek and Scythic kings" pp. 129 ff.

Cunningham : "Num. Chr." 1892, pp. 63 ff.

† Kern : *Manual of Ind. Bud.* (Grundriss d. Indo.-Arischen Phil.) p. 122.

Hinduism was now very much alive. After the Third Council the distinction between the Hinayánists and the Maháyánists became more and more accentuated. The apostles of the latter development became convinced that in order to draw into their folds the bulk of the people some sort of compromise was necessary, that orthodox Buddhism in all its rigidity must be given up. In other words, the neo-Buddhism which now sprang into existence began to absorb and assimilate the popular form of Brahminism and thus swell the ranks of its followers. A purely ethical creed has never secured a following except perhaps among a chosen few. To quote the eloquent words of the historian of "Rationalism in Europe" :—

"There arise from time to time men who bear to the moral condition of their age much the same relations as men of genius bear to its intellectual condition. They anticipate the moral standard of a later age, cast abroad conceptions of disinterested virtue, of philanthropy, or of self-denial that seem to bear no relation to the spirit of their time, inculcate duties and suggest motives of action that

appear to most men altogether chimerical. Yet the magnetism of their perfection tells powerfully upon their contemporaries. An enthusiasm is kindled, a group of adherents is formed, and many are emancipated from the moral condition of their age. Yet the full effects of such a movement are but transient. The first enthusiasm dies away, surrounding circumstances resume their ascendancy, the pure faith is materialised, encrusted with conceptions that are alien to its nature, dislocated, and distorted till its first features have almost disappeared. The moral teaching being unsuited to the time becomes inoperative until its appropriate civilisation has dawned, or at most it faintly and imperfectly filters through an accumulation of dogmas, and thus accelerates in some measure the arrival of the condition it requires." Vol. i, p. 305, Ed 1900.

The same historian in explaining the rapid spread of Christianity in Europe observes in another place :—"It triumphed not so much by superseding rival faiths as by absorbing and transforming them. Old systems, old rites, old images were grafted into the new belief, retaining much of their ancient character, but assuming new names and a new complexion."

Among the bold spirits who took a leading part in this renovation the name of Nágárjuna stands conspicuous. The Mádhyamika system, with its axiom—*sarvam Sunyam*—a form of Pyrrhonism pushed to its extreme limits,

Nágárjuna : a leading representative of Maháyánism.

which is an essential part of Maháyánism, is generally ascribed to him. Northern Buddhist literature is replete with the marvels and miracles performed by him, and tradition has invested him with superhuman powers, Hiouen Thsang calls him along with Deva, Asvaghosha and Kumáralabha, "as the four suns which illumine the world."* As early as A.D. 401-409 we find a life of Nágárjuna Bodhisattva translated into Chinese.† Táránátha has committed to writing all the floating mass of legends connected with this venerable name, but as the Tibetan monk wrote so late as the beginning of the 17th century A.D., and as nothing was too astounding for his pious credulity, we have here only

* Julien's texts, Vol. ii, p. 214.

† Sen. Nanjio's Catalogue, Ap. i, No. 3.

nuclei of facts round which have gathered accretions of vast proportions. It is now almost a hopeless task to separate the grain from the chaff. Nevertheless we can glean certain historical data from all that have been handed down. Before proceeding further we think it proper to treat the reader to a specimen of the materials with which one has to deal. We call the following bits from the "Life and Legends of Nágárjuna" gathered chiefly from Tibetan records including Táránátha's "History of Buddhism."

"A rich Brahmin of the Vidarbha country to whom no son had been born for many years, once saw in a vision, that if he gave alms to, and entertained one hundred Brahmins, he could get a son. Accordingly he made offerings and prayers to the God and entertained one hundred Brahmins. After ten months his wife gave birth to a son. The rich man invited learned astrologers to predict the fortunes of his child; but they found that it could not live more than a week. In all other respects the child was calculated to be fortunate..... The astrologers assured them (his parents) that if they entertained one hundred Bhikshus, it would

live seven years, beyond which its life could not be prolonged by any means whatever. When the seventh year was about to expire the parents were overwhelmed with grief. To avoid the painful sight of their son's predicted death, they caused him to be removed to a certain solitary place in company with a few retainers.

"As the boy (Nāgārjuna) was passing his mournful days, one day the Mahābodhisattva Avalokiteśvara Kṣaṣarpama visited him in disguise and advised him to go to the great monastery of Nāleन्द्रa in Magadha as the surest means of escaping from the hands of death. He accordingly repaired to that famous Vihāra and arriving at the gate recited some gāthās. During that time the great sage Śrī Saraha Bhadra was the high priest of Nāleन्द्रa, who ordained Nāgārjuna a Bhikshu of the Vihāra. * * * * During the latter part of his office the country was visited by a famine in consequence of which the monks fell into great distress. The Manager became very thoughtful about the terrible effects of the natural calamity. Distress and scarcity compelled the congregation more keenly to feel the necessity of money. The monks now determined to devise some means of acquiring treasures for the support

of the famished congregation, and Nāgārjuna accordingly started on an expedition to visit an island in the great ocean where lived a great saint well versed in the art of alchemy. As the sea could not be crossed by any earthly means, he, by dint of his divine learning, got two leaves of an enchanted tree, by means of which he crossed the ocean and miraculously visited the island and presented himself before the sage who was greatly surprised to see a human being arrived at his abode deemed inaccessible to mortal beings. The sage earnestly inquired how he succeeded in achieving this wonder. Nāgārjuna replied respectfully stating to him the reasons of his visit and circumstances that brought him thither. He also showed him one of the enchanted leaves, concealing the other in his mendicant's platter. He begged him to teach him the art of turning metals into gold. The sage consented to the proposal, but not liking to let the wonderful art be known in Jambudvīpa, he determined to detain him for ever in the island by depriving him of the enchanted leaf. To effect this, he said that he could not teach the art of alchemy unless Nāgārjuna consented to part with the leaf. Nāgārjuna consented, and was taught the art. When it was fully mastered, he flew towards the Indian Continent by the help

of the remaining leaf. Returning to Nālandra, by means of his easily acquired wealth he supported the whole body of monks. By his religious practices he obtained Siddhi (perfection). He refuted the theories of Saṃkarāchārya* and imparted religious instruction to the monks of Nālandra.

"Nāgārjuna returned to his country after a visit to Uttarakuru and erected many chaityas and temples, composed many works on science, medicine, astronomy and alchemy. After the death of Saraha Bhadra, the office of high priest fell upon Nāgārjuna, which he managed with great ability and indefatigable zeal. He matured the Mādhyamika philosophy which was only conceived by his illustrious teacher Saraha."

"Nāgārjuna is said to have been a great friend of king De-Chye (Saṃkara) of S. India, whom he converted to Buddhism."

* An instance of glaring anachronism. Saṃkara flourished in the 8th.—9th century A. D. See below, foot-note to p. xxii.

+ S. C. Dās : Journ. As. Soc. ii, Pt. i, pp. 115—129.

One thing seems to be clear from the above, namely, that Nāgārjuna was born and brought up in the Brahminical faith but was afterwards converted to Buddhism and was celebrated as an alchemist.

Tāranātha, it is true, completed his History in 1608 A. D., * but he derived his materials from Tibetan sources and the analysis of Dulva by Csoma goes to confirm this account. We have already made use of the record left us by Hsüen Tsang. † It is thus clear that all the testimonies concur in ascertaining Nāgārjuna not only as the originator of the Mādhyamika philosophy but also as an adept in magic, conjuration and alchemy, and that even so early as the 7th century A. D. The exact time during which he flourished is a matter of controversy. He is generally regarded as a contemporary of

Nāgārjuna as an adept in magic and alchemy.

* Schiefner : *Gesch. d. Bud.* Pref. vi.

† *Ide* Vol. i, Intro. xciii.

Kanishka. One cannot go far wrong in assigning *circa* 150 A. D. as the date of his succeeding to the Patriarchate.*

* According to Lassen Nāgārjuna lived about A. D. 23 during the reign of Kanishka. The *Rājataranginī* says: "Then there were in this land three kings called Hushka, Jushka and Kanishka, who built three towns named after them (Hushkapura, Jushkapura and Kanishkapura)..... During the powerful reign of these [kings] the land of Kāśmīr was to a great extent, in the possession of the Buddhas. At that time 150 years had passed in this terrestrial world since the blessed Śākya Śiṃha (Buddha) had obtained complete beatitude (Nirvāṇa)..... And a Bodhi-mitra lived (then) in this country as the lord of the land, namely, the glorious Nāgārjuna..... Stein's trans. Vol. I. pp. 30—31. As the tradition of the Northern Buddhists as recorded by Hiuen Tsiang (*Si-yu-ki*, I. pp. 99, 151, the Tibetan *Dadra* (Cecma, *As. Res.* XX, pp. 92, 297) as also Schiefner (*Tur. Gesch. d. Bud.* p. 301) concur in placing the commencement of Kanishka's rule 400 years after Buddha's Nirvāṇa, the date assigned here to Nāgārjuna is rather curious. Lassen sums up his conclusion on this knotty point in these words:—"Wegen der grossen Anzahl seiner Münzen muss dem Kanishka eine ziemlich lange Regierung zugesprochen werden; ich glaube daher annehmen zu dürfen, dass er etwa bis 40 nach Chr. G. regiert habe." Fleet maintains B. C. 57. V. Smith *c.* 120 A. D. While Messrs. Bhāndārkar *c.* 278 A. D. (*Journ. Bombay Br. Roy. As. Soc.* Vol. XX, No. Ivi, pp. 269—365) as the date of Kanishka.

An important document has been preserved or us in its Tibetan and Chinese versions, which seems to have an historical basis. It is in the shape of a "Friendly Epistle of Nāgārjuna to king Udyana."*

Nāgārjuna as a contemporary and friend of king Śadvāhana.

The original in Sanskrit, entitled *Sukrīḷlekha*, has not yet been recovered and probably

been lost. Udyana in the Tibetan subscription is Bdye-Spyod = Śadvāhana.† This Śadvāhana is a prominent figure in the history of S. India. In ancient Śanskrit literature he is frequently spoken of as a patron of learning and there are several literary reminiscences associated with this name.‡

* Vide Wenzel : Journ, Pali Text Soc. (1886), p. 1.

† S. C. Dās (l. c.) says : "Nāgārjuna is said to have been a great friend of king De-Chye (i. e. Saṃkara) of S. India whom he converted to Buddhism." Now De-Chye = Bdyehyd according to modern pronunciation. Dās is evidently in error in rendering De-Chye as Saṃkara (Wenzel).

‡ Cf.—Kāmasūtra of Vātsyāyana. कर्मस्यो कुलस्यः प्राप्तकविः ज्ञानवाङ्मनो महादेशो मलयवर्तो [जघान] : Referring to a "new" MS. of *Harshacharita* in his possession Hall remarks—"for Śālivāhana I there find Śātarāhāna"—Intro. to "Vāsurvadattā," p. 54. This by implication would suggest that the other MS. had the reading Śālivāhana.

Now "the Andhrabhrityas or Sātavāhanas ruled over the Deccan from B. C. 73 to about A. D. 218, i.e., for about 3 centuries.

"The period during which they ruled over Mahārāshtra must have been a prosperous one in the history of the country. Hence several traditions with regard to different kings have been preserved. But that Sālivāhana or Sātavāhana was a family name must have been forgotten and different princes of the dynasty have been confounded and identified. Thus Hemachandra in his Desikosha gives Sālivāhana, Sālana, Hāla and Kuntala as the names of one individual." *

The So-to-p'ao-ho of the Chinese version of the "Friendly Epistle" has been identified with one of the Sātavāhanas or Andhra kings, possibly Yajna-Srī-Sātakarni, who seems to have reigned about 172—202 A. D. There is, therefore, nothing improbable in this particular, Sātavāhana being a contemporary of Nāgārjuna. In the alchemical Tantra, "Rasaratnākara," ascribed to Nāgārjuna,

* Bhāṇḍārkar's "Early History of the Deccan"—p. 26.

there is a dialogue between this sage and Śālivāhana (p. 6). We shall revert to this subject later on.

Numerous works have been fathered on Nāgārjuna and it is an open question if any of them be genuine.* As is well known Vyāsa or more properly named Vedavyāsa has been taken to be the compiler of not only the four Vedas but also of all the Purāṇas put together. Piety and credulity go hand in hand and are seldom troubled with questions of anachronism. Plato, Democritus and Geber have been held responsible for writings which appeared several centuries later.

Nāgārjuna as a comprehensive name of the activity of Mahāyānaism.

Names, venerable and illustrious, have often been pressed into service to lend weight and dignity to productions which otherwise would not have commanded a respectful hearing. On the whole we are inclined to agree

* In Bunyiu Nanjio's Catalogue of the Bud. Tripiṭaka there is a list of 24 works ascribed to Nāgārjuna. The *Subhīṭlekha* was translated into Chinese in 434 A. D. App. pt. I, p. 368.

with Kern when he says, "The figure of Nāgārjuna, so prominent in the history of the rise of Mahāyānism, shows a double character. It is, on the one side, the name of an influential person, the first eminent leader of a school imbued with Hinduism and the methods of Indian scholastic philosophy. On the other hand, Nāgārjuna is simply a comprehensive name of the activity of Mahāyānism in the first phase of its onward course."*

* In Vol. I of this work (Intro. xchii), we quoted Al-Bīrūnī as to the date of Nāgārjuna. This cultured Arab, ordinarily a very trustworthy guide, derived his information from the Brahmins of that part of India from which every vestige of Buddhism had disappeared in the 11th century and he was evidently misled on this point as the traditions relating to Nāgārjuna had at that distance of time become very vague. This will be clearly seen from what Prof. Sachau says in the preface to the Arabic edition of Al-Bīrūnī.

"Its civilisation was then essentially Brahminical as it had come to be in a protracted struggle with Buddhism. Al-Bīrūnī does not know Indian Buddhism from personal experience though it had not yet entirely withdrawn from India and in some part was still a political power. (p. v.)

"The valley of the Kābul river and the Punjab are all that Al-Bīrūnī has seen of India. (p. xiii.)

"The high schools of Hindu science and learning, Kashmir and Benares, were in Al-Bīrūnī's time unapproachable for Muslims. (p. xiv.)"

From the time of Nágárjuna onwards Maháyanism began to be tinged more and more with Brahminical bias. A notable and decided step in this direction was taken by Asaṃga, a monk of Gándhára, who composed the Yogáchárabhūmisastra, in which by assimilating the doctrines of Patañjali he paved the way for the growth of Tantras. He seems to have lived about 400 A. D.* Vāsubandhu, Asaṃga's younger brother, was another zealous

* Cf.—Takakasu : Journ. Roy. As. Soc. 1905.

A life of Vāsubandhu was translated into Chinese by Paramārtha. A. D. 557-569.—Bun. Nanj. Cata. p. 371. Csoma Korosi following the Tibetan Chronology says :—"I know that Arya Asaṃga lived in the sixth or seventh century after Jesus Christ." As. Res. XX, p. 513. This date has been accepted by Lassen (*Ind. Alt.* ii, p. 460) as also by R. Davids (*Buddhism.* p. 267). But this chronology has now become untenable. The date of Asaṃga and his brother Vāsubandhu should be put back by about two centuries, as some of their works were translated into Chinese in the beginning of the 5th century and perhaps earlier. (Bun. Nanj. Cata. App. i p. 371). It must have taken a century or two to have their works sufficiently recognised in India before they would deserve a place in the Chinese Tripitaka.

lous adherent of this school and is said to have been a teacher in the college attached to the monastery of Nálendra—the “Oxford of Indian Buddhism.” From Tibetan sources we learn that the celebrated logician Dig-nāga was a disciple of Vasubandhu, a contemporary of Lha-tho-ri, king of Tibet, who lived up to 371 A. D.*

Maháyánism now began to adapt itself to its environments. The absorption of the Yoga ideas made the transition into the Tantric cult easy and Northern Buddhism began to develop and expand by entering into an alliance with Saivism, which favoured the growth of Buddhist Tantras. The origin and development of this class of literature have been the subject of a masterly exposition by Burnouf. The Maháyánists not only set up their own deities but borrowed copiously from the pantheon of the Hindus. Thus in the Sivaite Tantras while

* S. C. Vidyābhāṣana : Journ. As. Soc., Vol i, (1905), p. 227.

the God *Siva* is the fountain of all knowledge and sciences, in their Buddhist counterparts we have the celestial, metaphysical and potential Buddhas* occupying the same position. The worship of the female energies (*Sakti*) which plays such an important part in the Tantras was encouraged in the person of *Tará*. The Hindu Gods and Goddesses were also objects of adoration, only they were assigned a subordinate position. The question has often been asked : why did Buddhism seek alliance with Saivaism in preference to the Vishnuvite cult ? The answer seems to lie in the fact that it was precisely in those parts of India where the worship of *Siva*, especially in its Tántric form, had struck root that Maháyánism asserted its sway ; † and thus the apostles and propagators of the latter made most of the former. A few centuries later when Vaishnavism gained an ascendancy in Bengal the tables seem to have been turned. A gradual and imperceptible fusion

* i. e. the Bodhisattvas.

† Vide *ante*, p. xi, (under *Wema kadiphoes*).

took place between the rival creeds. Thus in the celebrated adoration in the opening lines of *Gitagovinda* we find Buddha freely acknowledged as an incarnation of Vishnu and extolled for his abhorrence of sacrificial rites.*

From Fah-bian's travels we gather that in the beginning of the 5th century A. D., the Maháyánists were gaining the upper hand, though their rivals, the Hináyánists, were still holding their own in several localities. Thus at Mathurá and Pátaliputrā he found the members of both the sects living side by side and having monasteries of their own.

* *सिद्धोऽस्य यज्ञविघ्नोऽहं श्रुत्वा तस्मै सदा यज्ञददमि तपयचातम् । ईश्वरं
ब्रह्मब्रह्मरीरं कथं जगदीशं हरिम् ॥*

It is scarcely correct to assert that Buddhism was exterminated in the land of its birth by cruel persecution. *Cf.* Vol. i. Intro. lxvii. The Bengali poet Rāmachandra Kavibharati, author of *Buddha Satakā*, though a devoted Buddha, belonged to the same class of thinkers as Jayadeva. Pandit S. P. Sāstrī is inclined to place him in the latter end of the 13th century.—*Journal of Buddhist Text Society*, Vol. I. Pt. iii. So late as 1441 A. D. MSS. of Buddhist works used to be copied from in Magadha.—Bendall's *Cata. of Bud. Sans. MSS.* (1883), pref. iv.

From the fact, however, that the pious Chinese pilgrim repeats the *Surāṅgama Sūtra* for his protection, we may conclude, since he is by no means a pronounced Mahāyānist, that the predisposing causes for the origin of the Tantras were already in existence. "In this Sūtra is contained the most complete list of Dhāraṇīs (invocations) found in any Chinese compilation. There are 426 distinct sections containing the names of the different Buddhas and Hindu deities worshipped at the time of the composition of the Sūtra. Considering that Fah-hian in the early part of the 5th century regarded this book with reverence. We may reasonably assign it to a period not later than the end of the 1st century. Now amongst the invocations we find distinct reference to Dhyāni Buddha, Vairochana, Akshobhya, Amitābha and others shewing that they were coming to be recognised and worshipped even at that early date." *

* Intro. to Beal's "Fah-hian," (Lxxii).

These Dháranis may be looked upon as the precursors of the Tantras and they fully support the views that when they were composed Buddhism had turned a new leaf. The repeating of certain magic formulas along with the names of Buddha Amitábha, etc., was to secure salvation, in other words, "instead of the old doctrine [of *Karman*]—as a man soweth, so he shall reap—a new and easier way of salvation is here preached, viz., as a man prayeth, so he shall be saved. It is what is known to us as salvation by faith rather than by works. It would almost seem as if this popular and easy doctrine had secured to itself the name of Maháyána, as meaning the Broad Way, in opposition to the Narrow Way, the Hina-yána.*

The new class of literature which now arose in order to meet the demands of the Maháyánist revival is collectively known as

* Max Müller, *Buddhist Maháyána Sūtras*, Intro. to larger *Sukhāvati-Vyūha*, ix . S. B. E. Series, Vol. xlix.

the Vaipulya Sūtras or the Sūtras of the developed school, of which the Dhāraṇīs are an integral part. It found expression in such works as the "Śaddharmapundarīka," "Lalitavistara," "Tathāgataguhyaka," "Prajñāpāramitā," etc., —all of which soon acquired almost canonical sanctity in the estimation of the N. Buddhists. Burnouf has tried hard to differentiate between the simple Sūtras as represented by the literature of the primitive orthodox Buddhism and the expanded Sūtras of which the distinguishing mark is the occurrence of Bodhisattvas.* This drawing of hard and fast

* "La présence des Bodhisattvas ou leur absence intéresse donc le fonds même des livres où on la remarque, et il est bien évident que ce seul point trace une ligne de démarcation profonde entre les Sūtras ordinaires et les Sūtras développés. —Burnouf, Intro. p. 112; *ibid.*, p. 120. Ed. 1844. *Vide* Max Müller's remarks at the end of the Smaller Sukhāvatī-Vyūha, p. 102, S. B. E. Series, Vol. xlix.

Cf. also "Some Vaipulyas are, materially, much like the old Sūtras, whole passages *e.g.* of Lalita-Vistara recur almost word for word in the Pāli Scriptures." Kern (*Ind. Bud.* p. 5). This eminent Buddhist scholar also very appositely re-

lines has been found to be well-nigh untenable.*

By the second century A. D. we find the leading beliefs and ideas as crystallised in the Mahāyāna literature fully in vogue. Thus we

marks elsewhere: "The results arrived at by Burnouf may be right so far as Mahāvaiṣṭya Sūtra as a whole is concerned, they cannot be applied to all the component parts of such a work. Not to go further than the Saddh. and the L. Viṣṭara, it can hardly be questioned that these works contain parts of very different dates, and from various sources."—Kern, Intro. to Saddh., pp. x-xi. Passages in L. V. are literally identical with those in Mahāvagga. Again:—"These few examples I have chosen will suffice to prove that the material of a Mahāvaiṣṭya Sūtra is partly as old as that of any other sacred book of the Buddhists."—*Ibid.*, xiv.

* The truth seems to be that "the historical relation between the Hinayāna and the Mahāyāna schools of Buddhism is to me as great a puzzle as ever."—Max Müller, Intro. to L. Sukh. Vyākha, ix. Even the very distinction between the N. and the S. Buddhism has been taken strong exception to by R. Davids, who says:—"There is not now and never has been, any unity either of opinion or of language in what is called northern, or in what is called southern Buddhism. There is a distinct disadvantage in continually suggesting a unity which has no existence in fact. In a word the current division of Buddhist literature into northern and southern is entirely unscientific, and misleading."—*Bud. India*, p. 173.

come across in the "Buddhacharita" of Asvaghosha, who is admitted on all hands to be a contemporary of Kanishka, such a passage as this: "this, Sirs, is the Mahāyāna, the instrument of the law of the perfect Buddha, which is the establisher of the welfare of all beings, set forth by all the Buddhas."* The "Lotus of good Law" was translated into Chinese at the close of the second century A. D. †

Side by side with the growth of the scriptures another class of literature was called into being by the exigencies of the times—we mean the Buddhist Tantras, the necessity for which has been hinted at in the first volume. ‡ However esoteric may be the doctrines sought to be conveyed through the medium of these productions, it would be idle to deny that there

* Cowell's trans. p. 184. S. B. E. Series, Vol. xlix.

† Edkin's "Chinese Buddhism," p. 89. There were several versions of this sacred book.—*Vide* Kern's Intro. p. xxiii (S. B. E. Series).

‡ Vol. I. Intro. lxx.

is much in them which is calculated to pande-
 der to the baser instincts of frail humanity.
 At what particular time these Tantras ap-
 peared on the scene is yet a matter of con-
 jecture, but the views of Wilson which held
 the ground for more than 30 years have now
 been found to be erroneous. Evidence is
 now forthcoming from quite an unexpected
 source, which goes to prove that Buddhist
 Tantras existed as early as the fifth or sixth
 century A. D., if not earlier. * If Buddhist
 Tantras, again, pre-suppose the existence of
 Hindu Tantras, one need not be considered as
 rash in assigning an earlier age to the latter.†

* *Vide* the palm-leaf MSS. discovered in the monastery of Horiuzi in Japan and carried from Central India. One of these is in the handwriting of a famous Chinese priest, named Kanshin, who came to Japan in A. D. 753. The MS. contains besides a Dhāraṇī, five Tantras. "Bud. Texts from Japan," ed. by Max Müller. Vol. i, pt. i, Intro. pp. 6-8. It is fair to conclude that these Tantras existed in the land of their birth at least two centuries earlier.

† Waddelsays :—"No one has yet realised the vast extent to which Mahāyāna and Tāntrie Buddhist remains cover India; nor sufficiently realised the leading part played by the Mahāyāna in Indian Buddhism during its popular period," *Journal of the Roy. As. Soc.* (1894).

The Tantras found a congenial home in China. Amoghavajra, a Śramaṇa of northern India and a Brahmin by caste resided in the Celestial Empire for several years between 746 and 771 A. D., and under his influence the Tántric doctrines dealing with talismanic forms and professions of supernatural power first gained currency there. Hence long before his time Tantras must have been popular in India. From the eighth to the eleventh century A. D. we are in possession of authentic records as regards the prevalence of Tantras in Northern India; as it was about this period that several of these were gradually imported into Tibet by Indian Pandits, but they must have been composed much earlier. †

Tantras imported
into Tibet.

* Ben. Nanjio's *Cata.* App. ii, p. 445. Amoghavajra translated 77 works including *Ukṣvīṣa-chakravartī-tāntṛa*, *Garuḍagarbha-tāntṛa* and *Vajrakumāra-tāntṛa*.

Q.—Also "The existence of the Tantra Śāstras may thus apparently be traced at least as far back as the 6th century A. D."—*Vide* "Annual Report," As. Soc. Beng. 1906.

† In the first half of the eighth century two eminent

Atisa gave a fresh impetus to Tantrism in the land of snow. From the analysis of Mdo by Csoma we also come to know in detail the names with the dates of the Indian scholars who with the aid of the local interpreters (*lochans*) rendered into Tibetan the various Sanskrit Tantras. The faithful accuracy with which these translations were made and their fidelity to the original enable us often to reproduce the Sanskrit Texts and thus we are in possession of valuable histori-

Pandits of Bengal visited Tibet at the invitation of its king and formally introduced there Buddhism; these Pandits were Sānti Rakshita, high priest of the monastery of Nālanda and his co-adjutor Padma Sambhava, a native of Udyana, who took charge of the Tantric part of the Buddhist liturgy. They were followed by the sage Dīpanakara-Srī-jāna (Atisa), b. A. D. 980, d. 1053. He acquired proficiency in the three pitakas of the four classes of the Hīnayāna, Śrāvakas, in the Vaisesika philosophy, in the three pitakas of the Mahāyāna doctrine, the metaphysics of the Mādhyamika and the Yogācārya schools and the four classes of the Tantras. At the request of king Nya Pāla he accepted the post of high priest of the monastery of Vikramasila.—*Vide* S. C. Dās,—Journal of the Buddhist Text Soc. Pt. i.

cal data.* Some of these Tantras deal with alchemy and their contents reveal to us the knowledge of chemical processes in India from about the 6th to the 8th century A. D.†

Fortunately we are not dependent upon the Tibetan Tantras alone for gaining an insight into this dark recess in the history of Hindu intellectual activity. In the course of our search

* Speaking of the Tibetan translation of Arvaghoṣa's *Buddha-Charita*, Cowell remarks: "The Tibetan version appears to be much closer to the original Sanskrit than the Chinese; in fact from its verbal accuracy we can often reproduce the exact words of the original, since Sanskrit words are always represented by the same Tibetan equivalents, as for instance the prepositions prefixed to verbal roots."—*l. c.* Intro. p. x. Waddel is equally impressed with the "profoundly accurate and scholarly nature of the Lāmaist translations of Sanskrit Buddhist books;" and he again observes: "It is clear that the Tāntrie and Mahāyāna features of Lāmaism were imported *en bloc* from Indian Buddhism,"—*Journal of the Royal As. Soc.* for 1894, p. 15.

† Analysis of the contents of the *Mān* (Sūtra) by Cooma de Koroal—*Asiatic Researches*, XX (1836), p. 583. "A work on preparing quicksilver, the most powerful for subduing every sickness and for improving the vigor of the body."—"A work on turning base metals into gold." We are thus reminded of the contents of the *Rasāraṇva* and the *Rasaratnākara*, *Vide* p. 2.

for MSS. of alchemical Tantras we have come upon a precious find, in the shape of a Buddhist Tantra, with Nāgārjuna as its reputed author. Of alchemical Tantras we have had enough and to spare ; but there is great difficulty in assigning dates to them, as they one and all pretend to emanate from the mouth of the God Siva himself. We are only left to internal evidences—evidences based upon the gradual evolution of chemical processes, which we have not been slow to take advantage of. The MS. in question is a mere fragment, but it is calculated to

Its historical
importance.

evoke all the zeal and enthusiasm of a Palæontologist—of an Owen or a Marsh—in his efforts to restore an animal and assign to it its proper place in the economy of the laws of evolution, when he luckily chances upon a fossil impression of its tooth or claws. From this point of view Rasaratnākara, for such is the name of our MS., is of uncommon interest. It is a Tantra of the Mahāyānist school and as such its invocations are

addressed to all the Buddhas ;* and in one place there is a pointed reference to Prajñā-pāramitā †(perfection of wisdom) appearing before Nāgārjuna in a dream and revealing to him chemical knowledge.‡

A noteworthy feature of this work is that some chemical processes are discussed in the form of a dialogue between Sālivāhana and Nāgārjuna, and Ratnaghosha and Māndavya.§ These last two names are held equally in veneration with Nāgārjuna and grateful acknowledgments to their services occur in some later chemical treatises.¶ The bringing together of these four *dramatis personæ*.

* अथियन्तु सर्वैर्बुद्धान् । Cf. The opening invocation in the Sukhāvastī Vyūha : श्री नमः श्रीसर्वैर्बुद्धश्रीविद्यार्देवः । also नमः सर्वैर्बुद्ध आदेवावकाशान् नमो श्रीविद्यारामान् in A'rya Mañjuśrīmūla Tantra. — Vide As. Res. xx, p. 512.

† Cf.—The invocation in Vajracchhedikā नमो जगदग्रा आर्यैर्बुद्धावरमिताहे.

‡ Vide Sans. Texts, p. 10, also Trans., p. 5.

§ Vide Sans. Texts, pp. 12-14, also Trans., pp. 6-8.

¶ Cf. Vol. i, p. 77.

especially of the first two has a significance of its own. We have already seen that references to Nāgārjuna and his contemporary king Śālivāhana are only to be met with in ancient classical literature (*vide ante* xxii). It seems probable that Rasaratnākara was written at a time when the memory of these personages was still fragrant. Judging from internal evidences also we come to the conclusion that it is one of the earliest works extant on the subject. In our attempt at throwing light on the text of Rasāraṇya, we had to quote several parallel passages from it,* and from a careful perusal of both we are of opinion that the latter is the inspirer rather than the borrower. Rasaratnākara, in short, seems to us to be a

Also a typical production of the Mahāyānist period of intellectual activity.

typical production representing the Mahāyānist period of intellectual activity and we may not be wide of the mark if we put down 7th or 8th century A. D. as its latest date.

* *vide* Vol. i, Sans. Texts, pp. 7, 12, 13 and 18.

From the 5th to the 11th century A. D. the colleges in connection with the monasteries of Páṭaliputra, Nálándá, Vikramasila, Udayāpura, etc., were the great seats of learning as the temples attached to the pyramids in ancient Egypt ; and alchemy was included in the curricula of studies.*

The existence of a vast ancient Tántric literature with alchemy as a component part has now been placed beyond doubt, thanks to the searching examination of the Mahárájá's collection of valuable MSS. of Nepal by the eminent scholars Bendall, H. P. Sastri and S. Lévi. Of surpassing interest is the discovery of a Tantra belonging to the extinct school Kubjikánata, written in Gupta character and copied about the sixth century A. D. This

* Cf. "By the side of the tower of king Asoka is built a Samghārāsa, belonging to the great vehicle, very imposing and elegant. There is also a temple belonging to the little vehicle.....In the college attached to the temple one may see eminent Sramanas from every quarter of the globe."—Beal's "Fah-hian," ed. 1860, p. 105.

school, though itself very ancient, presupposes the existence of other schools and we have distinct mention of the Maháyāna.* We now learn that the gradual fusion and amalgamation of Sivaite and Buddhist Tantras had begun even anterior to the sixth century. The Kujjiká-tantra was evidently composed outside India proper, probably in Nepal. The Goddess Párvati encourages her consort to proceed to the continent for the spread of the tenets propounded by it. † In one place we come across a passage ‡ in which Siva himself speaks of párada (mercury) as his generative prin-

* Catalogue of Palm-leaf and selected paper MSS. belonging to the Durbar Library, Nepal, by H. P. Sastri (1905). lxviii, *et. seq.*

द्विषे दीवानौ तु विद्वानसकौनरे ।

मध्यमे तु मन्त्रायाम् शिवसेना वलीयते ॥

† गण्डर्भ भारते नष्टेऽधिकाराय सम्यतः ।

‡ मदीयैः पारदो यत्र पतितः कुटिलं मण्डिः ॥

मदीयैश्च वसुधायां साकाश्यां वृत्ते बहिः ।

निहन्ति संकृताः सनः भस्मा बद्धमिन्द्रायाम् ॥

For the passages cited here we are indebted to the industry and courtesy of Pandit H. P. Sastri, who has wended his way through the bulky MS.

ciple and eulogises its efficacy when it has been killed six times.* We also find allusions to the transmutation of copper into gold with the aid of mercury. In short, we have ample references to alchemical processes described in the very technical terms in which *Rasāraṇḍa*, *Rasaratnākara* and other typical works of the Tāntric period abound. †

It is now only necessary to wind up this chapter with an extract from the work of an eminent Buddhistologist with this reservation that the growing influence of Tantrism began as we have seen long before the 8th century.

"The decline of Buddhism in India from the 8th century downwards nearly coincides with the

* Even at the present day mercury, which has been *killed* six times in succession, each time with an equal weight of sulphur *षड्गुणमर्दिता*, is reputed to be one of the most potent of remedies.

† e.g. *पथेन विद्धिती वेधः किं व्यस्यती न विध्यते ।*

रक्षविहं यथा ताम्रं न मृशसाधनां त्रजेत् ॥

For the the meaning of the word *वेध* (*Vedha*) see this Vol. p. 18, *footnote*, also Vol. i, p. 120.

growing influence of Tantrism and sorcery, which stand to each other in the relation of theory to practice. The development of Tantrism is a feature that Buddhism and Hinduism in their later phases have in common. The object of Hindu Tantrism is the acquisition of wealth, mundane enjoyments, rewards for moral actions, deliverance, by worshipping Durgā, the *Śakti* of *Śiva*—*Prajñā* in the terminology of the *Mahāyāna*—through means of spells, muttered prayers, *Samādhi*, offerings, etc. Similarly the Buddhist Tantras purpose to teach the adepts how by a supernatural way to acquire desired objects, either of a material nature, as the elixir of longevity, invulnerability, invisibility, alchemy ; or of a more spiritual character as the power of evoking a Buddha or a Bodhisattva to solve a doubt, or the power of achieving in this life the union with some divinity. There is an unmistakable affinity between Tantrism on one side, and the system of Yoga and *Kammattāna* on the other. Tantrism is, so to say, a popularised and, at the same time, degraded form of Yoga, because the objects are commonly of a coarser character, and the practices partly more childish partly more revolting.

"Tārānātha informs us that Tantrism existed and was transmitted in an occult manner in the period

between Asaṅga and Dharmakīrti, but that after Dharmakīrti's times the Anuttarayoga became more and more general and influential. Substantially his statement is certainly right. He adds that during the reign of the Pāla dynasty, there were many masters of magic, Mantra-Vajrāchāryas, who, being possessed of various Siddhis, performed the most prodigious feats.

"The kings of the Pāla dynasty, whose sway over Gauda and the adjacent regions lasted from about A. D. 800 to 1050, are known both from the annals and their inscriptions as protectors of the Faith. It was during that period that the monastery of Vikramasila was a renowned centre of Tantrist learning.

"The Sena kings, who followed the Pālas in the dominion over Eastern India, though belonging to a Hindu persuasion, were not hostile to the Faith. Still Buddhism declined during their reign and more so after the invasion of the country by the Muhammedans in A. D. 1200. The monasteries of Ulandāpura and Vikramasila were destroyed; the monks were killed or fled to other countries. The learned Śākyasrī went to Orissa, and afterwards to Tibet; Ratnarakshita to Nepāl; Bud-dhamitra and others sought a refuge in S. India, whilst Saṅgama-Srijñāna with several of his followers betook themselves to Burma, Camboja, etc.

And thus the Law of Buddha became extinct in Magadha.

"Many emigrants from Magadha rejoined their brethren in the South and founded colleges on a modest scale in Vijayanagara, Kalinga, and Konkan. The comparatively satisfactory condition of Buddhism in Dekkan about that time is attested by the rich donations to the monastery at Dambal."*

It will be noted that the monks of the monasteries of Udaudapura and Vikramsila on their dispersion carried with them their learning and arts in the same manner of the Byzantine Greeks on their expulsion from Constantinople bore with them their intellectual treasures to the Italian cities. In the kingdom of the Deccan and in Tibet the Buddhist refugees found hospitable asylums, † just as the Greek Philosophers did in the Florentine Republic under the Medici.

* Kern—Manual of Ind. Bud., pp. 133—134.

† Cf.—"The Deccan, which from the eleventh century was the refuge and centre of literary activity generally. In Hindustan it had been substantially arrested by the invasions and ravages of the Muhammadans,—Weber. Hist. Ind. lit. p. 283.

Some eminent orientalists, whose opinions naturally carry weight, have hitherto taken for granted that the knowledge of chemistry such as we find reflected in the Tantras quoted by Mádharma in *Rasesvaradarsana** was derived by intercourse with the Arabs.†

* Vol. i, Intro. lxxviii, *et seq.*

† *E.g.* Barth : "In regard to alchemy, anyhow in which the Sittars are zealous adepts, they were disciples of the Arabians, although other Sivaites had preceded them in the pursuit of the philosopher's stone. Already, in his exposition of the different doctrines of the Saiva, Śāyana thought he ought to dedicate a special chapter to the *Rasesvara-darsana* or "system of mercury," a strange amalgamation of Vedantism and alchemy. The object contemplated in this system is the transmutation of the body into an incorruptible substance by means of *rasapāna*, i.e., the absorption into it of elixirs compounded principally of mercury and mica, that is to say, of the very essential qualities of Śiva and Gaurī, with whom the subject of the operation is thus at length identified. This species of transubstantiation constitutes the *jīvanmukti*, or state of deliverance commencing with this present life, the sole and indispensable condition of salvation. It is clear that the devotional formulæ of the Vedānta are here only a sort of jargon, under which there lies hid a radically impious doctrine ; and it is not less clear that in this doctrine, which had from the fourteenth century produced a rather considerable literature, there is an infusion of Mohammedan ideas. The Arabs of the Khalifat had arrived on these shores in the character of travellers or merchants, and had established commercial relations and intercourse with these parts long before the Afghans, Turks, or Mongols, their coreligionists, came as conquerors."—"Religions of India," ed. 1891, pp. 210-211.

The attentive reader who has followed us all along could not have failed to notice that it was in the Universities of Nālandā, Udaṇḍapura and Vikramasīla, in Central India and Magadha, precisely the regions which were cut off from communication with the external world, that Tantric mysticism with alchemy as an integral part was cultivated and from thence spread to Bhot (Tibet) and the regions lying to the south-east of it,* and South India.†

* See under colophons to *Rasaśrīdaya* and *Rasaśāstra* respectively.

† The last rallying point of Hindu learning and sciences was the kingdom of Vijayanagara, which was in the heyday of its glory under Bukka I (A. D. 1354-1371) with Mādhaṇa as his prime Minister. Wilson says :—"The history of Vijayanagara is a subject of considerable interest in the annals of India, as the last barrier that was opposed to Muhammedan invasions, and that preserved the southern part of the Peninsula from foreign rule until a very modern period."—*As. Res.*, Vol. XI (1830), p. I. See also Sewall's "A Forgotten Empire"—(Vijayanagara).

CHAPTER II.

Having thus far prepared the ground for believing that alchemy along with other cognate branches of learning was the outcome of Indian intellectual activity, we shall now proceed to follow it up with its further development. At the outset it is, Further cultivation of alchemy. however, necessary to remember that on the decline of Buddhism the vigorous impetus which its followers gave to literature and science was not lost to India. Nay, during and after the revival of Brahminism under the Gupta dynasty and its successions we have some mighty intellectual giants whose productions will continue to shed lustre as long as the Hindu nation exists. Kālidāsa and Bhavabhūti, Brahma Gupta and Aryabhata, Saṅkara and Rāmānuja are names which may be regarded as the heritage not of India alone but of the entire civilized world. At the time of the Brahminic revival Buddhist works of acknowledged merit far from

being cast aside were held in veneration. Amarasimha in his Lexicon and Vāgbhata in his *Ashṭāṅgaśrīdaya* * as also the pseudo-Vāgbhata * commence with an invocation to Buddha, which has never shocked the tolerant spirit of the Hindu. Charaka and Suśruta also bear distinct impress of Buddhist retouching. The Buddhist Tantras became likewise a part and parcel of Hindu religious-philosophical literature,† the subject-matter of the former was incorporated into the latter, the names of Tārā, Prajñāpāramitā and Buddha being simply changed into those of Pārvatī and Śiva. In *Rasaratnākara* itself we have distinct indications that it is an admixture of both.

Buddhist alchemical Tantras absorbed into Hindu Tantras.

* Vol. i, p. 76.

† Speaking of a typical Buddhist production belonging to this category Burnouf observes: "Ce morceau est exclusivement spéculatif, et il nous offre une nouvelle preuve de l'alliance intime que le système des Tantras a contractée avec la philosophie bouddhique la plus élevée" (L. c. p. 543 ed. 1844).

It should thus be understood that the works under review in this chapter are based upon their Buddhist counterparts ; in short, there is no disposition to ignore the debt of obligation the authors are under to Nāgārjuna, Ratnaghoṣa, Mādavya and others.

In the introduction to the first volume we stated : "It is to be regretted that the several works quoted by Mādava [on the science of mercury] *Rasahridaya* alone seems to have survived to our days" (l. c. lxxxiii). Since then we have been fortunate enough to procure as many as three transcripts of MSS. of *Rasahridaya* by Govindabhagavat from different quarters. As Mādava speaks of this author in terms of the deepest reverence and regards him as "ancient,"*we think we should not err on the wrong side if we place the author some three

* Cf. Vol. i, Intro. lxxx.

तस्य वचनं गौतमसमन्यदाचार्यस्यैव रासिधरमहोदयस्यैव ।
रासिधरस्यैव निरुक्तिः ।

The qualifying epithet *महोदय* is only applied to venerable Rishis of old.

centuries before his time. If our surmise be correct, he should have lived about eleventh century A. D. The only personal allusion which the author has condescended to offer for the edification of posterity is that he wrote his book at the request of the king of the Kirátaland, *i.e.*, the region adjoining modern Bhutan. Portions of this remarkable treatise after a careful collation of the MSS. have been reproduced in the proper place. The worm-eaten fragmentary MS. produced from Benares is 386 years old. Internal evidence equally goes to establish the antiquity of this work. The author was evidently a Buddhist as we learn from the colophon to the Benares MS. (*vide* trans. p. 12). It is, however, not to be found either in the India office or the Nepal MS. This important omission is easily accounted for. It is the reluctance of the latter day Hindus to acknowledge their obligations to a Buddhist author.

Rasārṇava which has been noticed at length in the first volume and to which was assigned the 12th century A. D., as also *Rasaratna-*

samuchchaya (13th to 14th century), need not further arrest our attention.

The presentation of the various treatises of the Tantric and iatro-chemical periods under discussion in their exact chronological sequence is not an easy task ; in the absence of more definite information, we are afraid, we shall now and then have to hazard a conjecture.

The introductory lines of Books viii and ix of Rasaratnasamuchchaya, in which Somadeva is mentioned as the author of the descriptive part, led us to suspect that they are merely reproductions from "a standard work on the subject by Somadeva, no longer extant."* Our surmise has proved to be partially correct. We have at last been able to recover the supposed lost work. A transcript of a MS. of Rasendrachūdāmaṇi by Somadeva, preserved in the Library of the Deccan College, Poona, reveals to us the fact that

* Vol. i, p. 118.

practically all the important portions of this book have been woven into the text of *Rasaratnasamuchchaya*; and this gives us an additional opportunity of collating many doubtful passages in both. But the present work itself does not lay claim to originality. It makes a candid admission that it culls all its materials from pre-existing chemical treatises.* It further puts forward the alchemist Nandī as the inventor of the process of sublimation and of the *Koshthi* apparatus (Vol. i, pp. 69 and 89).† *Nāgārjuna*, *Dandī*, *Saṃbhva* and the sage *Brahmajyoti* are also spoken of as sources of his inspiration. We get very little inkling into the personal history of *Somadeva*, except that he was the ruler of a city named *Karavālabhairava*. The fact that *R. R. S.* lays *Rasendrachudāmani* so amply under contribution would suggest that the latter had become somewhat rare

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- * अथ यन्त्राणि ब्रह्मणे रसरात्र्याख्येनैकतः ।
समाख्येनैव समासीनं नीलदेवेन साम्प्रतम् ॥
- † अहोपातनयनं हि नन्दिनः परिकीर्तितम् ।
कीर्तिकायकमेतद्वि नन्दिनः परिकीर्तितम् ॥

or that its contents had been well-nigh forgotten when the former was compiled. Its date may therefore be put down between the 12th and 13th centuries A. D.

Another important work of this period is *Rasaprakāśa-sudhākara* by Yasodhara. The author of R. R. S. in the opening lines mentions the names of 27 alchemists to whom he is beholden, among which occurs that of Yasodhana. We have little doubt that the

*Rasaprakāśa-
sudhākara*,

correct reading is Yasodhara. We now find that there is very little original matter in R. R. S., it being made up of citations from *Rasārṇava* and the works of Somadeva and Yasodhara. We should not, however, be understood to retract the high encomiums we thought fit to bestow upon R. R. S. for "its methodical and scientific arrangements of the subject-matter, which would do credit to any modern work."* Its author has never laid claims to originality, but, on the contrary, has freely acknowledged the sources he drew upon. The student of

* Vol. i, Intro. lxxvii.

Hindu chemistry, however, like a weary but devout pilgrim, must wind his way through intricate and thorny paths and feel ineffable joy^३ at being able to approach the original fountain undefiled. It now transpires that the credit for the accurate observations on the metallurgy of zinc (Vol. i., pp. 88 & 156) really belongs to Yasodhara. While the author of B. R. S. always scrupulously admits that his work is a mere compilation, Yasodhara, on the other hand, is anxious to let the world know that the processes he describes have been verified by experiments performed with his own hands.* Among the authorities he cites are Nágárjuna, Devaśāstra (probably Rasāruava), Nandi, Somadeva, Svachchhandabhairava and Manthanabhairava. As Yasodhara quotes Somadeva, he must have been posterior to the latter by at least a hundred

* *Of.* सद्यसेन कृतं सत्यक् कारवं न दुर्लभं मया ।
 सद्यसेन मययोगिन कृतं सत्यक् युतेन हि ॥
 चातुर्वन्धकृतयोऽसौ सद्यसेन कृतो मया ।
 दृष्टव्यमययोऽर्थं कथितो नात्र संशयः ॥

years and he should therefore be placed in the 13th century A. D. *

Rasakalpa likewise seems to belong to this period. It is in the shape of a Tantra, but curiously enough it is not much troubled with consistency. In the opening salutation Siva, "the king of mercurial lore" and his consort Chandikā are reverentially bowed to—a procedure scarcely reconcilable with the position of a revealed document. The colophon at the end of each Chapter (*उपसर्ग*) claims the work to be a part and parcel of Rudrayāmala Tantra; at the same time due acknowledgment is made to the contributions of Govinda, the author of *Rasa-hridaya*, Svachchhandabhairava and other adepts.† Towards the end the author says : "The processes described have all been verified by me and not borrowed at second-hand from my teachers." Needless to add here that the God Siva would not have

* We are using a copy of the MS. preserved in the Ranbir Library, Kāsmīr. The readings are on the whole accurate.

† E. g. *उपसर्गसंक्षेपः* (*संक्षेपः*)

been at pains in justifying the necessity of his production with such a timorous apology. From internal evidence it is abundantly clear that it could not have been composed earlier than the 13th century A.D.

As the author has confined himself solely to a description of the metals, minerals and the processes of "killing" them with the agency of various apparatus and has not gone into the treatment of diseases with the aid of mineral preparations, he has been able to condense much important information within the narrow compass of a few short chapters.

Rasarājalakṣmī also deserves some prominence here not because of its intrinsic worth but because of the references to previous Tantras and alchemists, amongst which are Rasārava, Kākachandīvara, Nāgārjuna, Vyādi, Svachchhanda, Dāmodara, Vāsudeva and Bhagabat Govinda. We have also categorical mention of the purely Ayurvedic works such

as Charaka, Susruta, Hārīta and Vāgbhāta, to which our author is equally indebted.* From the colophon to the MS. procured from Benares we learn that the author Viśvaudeva was Court Physician to king Bukka.† If this statement be accepted—and *prima facie* there is no reason to question it—this treatise must have been compiled in the latter part of the 14th century. Internal evidence equally supports this date.

* *Vide Sanskrit Texts*, pp. 80-81.

† *Vide ante*, footnote, xlix.

CHAPTER III.

c. 1350 A. D.

We now proceed to examine the contents of another series of works belonging also to the Iatro-Chemical period ; the one characteristic feature of which is that opium is recognised as an official drug in the *materia medica* portion. These may be taken to date from the middle of the 14th century A. D.

Rasanakshaṭramālikā by Mathanasimha, physician to the king of Malwa, should find a place in this chapter. For particulars as to the contents the reader may consult p. 22. The date given by the copyist of the MS. is *Saṃvat* 1557 i.e. 1500 A. D. The work itself is therefore older.

Rasaratnākara by Śiddha Nityanātha, son of Pārvati, comes under this category.* The author gives the sources of his information and explains the object of his compila-

Rasaratnākara by
Nityanātha.

* Two editions of this somewhat voluminous work have been published—one by Ganesa Chandra Ghose (Calcutta),

tion in the following words : "Whatever has been revealed by Śiva in Rasāraṇḍava under the preparations of mercury ; the Dīpikā of Rasamaṅgala on mercury ; all that has been said by Nāgārjuna for the benefit of people afflicted with diseases, as also by Siddha Charpaṭi, by Vāgbhata and Suśruta,—all these and many other treatises on mercury and minerals being consulted, I have, after rejecting the drugs and medicines which have become rare and difficult to procure, put together [in my work] the essential features thereof. * * * * All that I have learned from my teachers and have been in a position to subject to practical tests has been incorporated into my work for the benefit of mankind." In addition to the authorities cited above Nityanātha quotes from Chakrapāṇi and Rasendrachūḍāmaṇi (*ante* liv).

the other at the "Venkateswara Press" (Bombay). We have compared the readings of these two editions with the MS. in the Library of the Sanskrit College, Calcutta. They agree fairly well.

Rasendrachintāmañi will next claim our attention. We have before us the printed copy, edited by Umesa Chandra Sena Gupta, late librarian, Sanskrit College, Calcutta, in which the text has been adopted, as the editor informs us in the preface, after collation of 3 or 4 MSS. We have carefully gone over this edition and compared its readings with those of a MS. procured from Benares and another from the Ranbir Library, Kásmir. All these agree in the main, but there happen to be certain omissions and additions, which form an interesting chapter in the history of interpolations in the literature of this description. To begin with : there is a dispute over its very authorship. Some MSS. ascribe it to *Mundhukanátha*, disciple of Kálanátha, others to Rámachandra. After the customary salutation there occur two couplets in the Calcutta edition, which are not met with in the Benares and Kásmir exemplars. In these the author is made to justify his *raison d'être* for undertaking his task in these words :

Rasendrachintā-
mañi.

"I shall give publicity only to such processes as I have been able to verify by my own experiments." Such protestations have already been noticed more than once.* In another place we have : "Those mercurial operations alone have found a place in my book, which I have been able to put to tests. Those who teach without being able to perform experiments labour in vain." This last couplet is quite out of place as it hangs like a tail to a long extract from Rasārṇava and is in fact conspicuous by its absence in the Benares and Kāśmīr MSS.† For the second time we find calomel designated as Rasakārpūra (lit. camphor of mercury ; vide vol. i, p. 250). This preparation no doubt occurs in the older

* Such pretensions put forth on behalf of the author, especially in the first person singular, lead one to suspect that they are later interpolations. In the Arabian alchemy Geber is often made to declare to the same effect : e.g. "J'ai expérimenté moi-même tout ce que je rapporte."—Berthelot, "La Chimie au moyen Âge," t. I, p. 338. The well known egoistic couplet in Susruta, Ch. i, चङ्गे हि यन्मन्त्रिरादिर्दिग्गः is generally regarded as an interpolation.

† The extract commences with लं माता सूर्यभूतानां.

works, e. g. Rasārṇava ; but it is described there as the white "ash" of mercury (sveta-bhasma). The recipe for calomel as given in the Calcutta edition, however, is quite different from that in the Benares and Kāśmir MSS. and it is altogether wanting in one of the MSS. in the Calcutta Sanskrit College Library. We are therefore not without suspicion that it has been foisted into the original composition. The author refers to Rasārṇava, Nāgārjuna, Govinda, Nityanātha, Siddha Lakshmiśvara, Trivikramabhaṭṭa and Chakrapāṇi. There is a lengthy colophon but no direct information can be derived from it as to the age of the author.

Rasasāra : It is a comprehensive but purely chemical work dealing with 18 operations on mercury ; various chemical processes are incidentally described, a good many of which, however, overlap each other. There does not seem to be any justification for coining a multiplicity of technical jargons to connote each of these. But prolixity was never regarded in the light of a vice by the

alchemical writers of the middle ages either in India or in Europe. The contents of *Rasasāra* often remind us of a poem on alchemy by George Ripley, canon of Bridlington in Yorkshire (b. about 1460), of which Rodwell says :—

"But we cannot point to a new fact which he elucidated. He divided all chemical operations into twelve processes—calcination, dissolution, separation, conjunction, putrefaction, congelation, cibation, sublimation, fermentation, exaltation, multiplication and projection. Several MS. copies of his poem exist in the British Museum, bound up with copies of the works of Roger Bacon and earlier writers. Here is a specimen of his rugged rhymes :—

The first chapter shall be of natural *Calcination*;
 The second of *Dyssolution*, secret and phylo-
 sophycall ;
 The third of our elementall *Separation* ;
 The fourth of *Conjunction* matrimoniall ;
 The fyfth of *Putrefaction* then followe shall :
 Of *Congelation Altyficative* shall be the Sixt,
 Then of *Oybation*, the seventh shall follow
 next."*

* *Vide* "Birth of Chemistry".

The author, Govindāchārya, as a devout Hindu, begins with his adoration of Siva and Vishnu and tells us at the outset that his treatise is a compilation and epitome based upon standard works on the subject and the contributions of the adepts. We have every reason to be thankful to him for the many hints he throws on the sources of his information. Of surpassing interest is his declaration that for a knowledge of certain processes he is indebted to the Buddhists of Tibet.* This must be taken to mean that the cultivation of alchemy had become neglected and almost forgotten in India proper and the earnest searchers for this lore had to repair during the time of our author to Tibet. Confirmatory evidence to this effect is equally

* एवं बौद्धा विज्ञानानि भाटदेवनिबन्धिनाः ।

Towards the close of his work the author again acknowledges his obligation to the Buddhists.

बौद्धमतं तथा ज्ञाना रक्षकारः ज्ञानो महा ।

We have in our possession five transcripts of the MSS. of *Rasasāra* procured from the Libraries of Kāśmīr, Tanjore, Ulwar, Madras and the Temple of the Goddess Kālī, at Ramnā, near Dacca, Bengal.

furnished in the colophon to *Rasahrūḍaya* (trans. p. 12). During the decadence of Buddhism and the corresponding ascendancy of Brahminism in Bengal, say about the 11th to 13th centuries A.D., this branch of science also found a safe retreat in the land of the *Kirātas* as we have already seen. Burnell, under the influence of his preconceived notion, namely that Indian alchemy owed its origin to the Arabs, very naively remarks: "By *Buddhas* he (the author) probably means the Muhammedans (of the vernacular Malayālam use of the word), though studies of this nature were much pursued by the later Buddhists."*

Some idea of the date of *Rasasāra* may be formed from the fact that there is mention of opium in it. But our author was evidently quite in the dark as to its origin; for, says he: "There are 4 different kinds of poisonous

* Catalogue of the Tanjore Palace MSS. pt. 1, p. 70. Burnell draws his conclusions from the reference to Buddhists in the colophon; but we have quoted above another passage in which distinct mention is made of the Buddhists of Tibet.

sea-fish, and it is from their foam that 4 different kinds of opium are derived, namely, white, red, black and yellow ; while others maintain that it is derived from the foam of the snake and it is very properly used for chemical operation,"* *e. g.*,—killing and fixation of mercury. From the context it is, however, doubtful if the narcotic drug is really alluded to here. But independently of the use of this term we may safely place this work in the 13th century A. D.

* समुद्र चौर जायको विषमःस्त्रासतुर्विधाः ।
 तेषां क्षेत्रं समुद्रस्य च हिमिनी विषं स चतुर्विधं ।
 केचिदहनि सर्पाणां कर्म स्नादहिकर्मकं ।
 यथा—सारथं दंतवधे च रक्तवधे च जारकं ।
 क्षारथं पीतवधे च लघुवधे च सारथं ।
 विषविदुत्तमं क्षेत्रं युज्यते रसवर्षेण हि ।

The Sanskrit word for opium, "shiphena," lit., foam of the snake, is of modern date. It is generally held that this word has been Sanskritised from the Arabic "aphiūn."

These identical disticha also occur in the commentary on *Śṛṅgadhara* by A'dāmaḷla with the additional line, सारथः (स्रावणः) क्षीरनिक्षेपः, namely, it is the milky juice of poppy ; proving that during the time of the latter its real origin was known, at the same time its supposed origin was not disbelieved.

Sārṅgadhara-saṃgraha—a compilation by *Sārṅgadhara* : its peculiarity is that it is based upon the *A'yurvedas* (*Charaka*, etc.) on the one hand and the Tantric chemical treatises on the other. In the chapter on the purification and incineration of metals, 7 of these are recognised, but strange to say there does not occur any mention of zinc. Later on, 9 metals are named including two alloys, brass and bell-metal, after the 9 planets, the significance of which will be discussed in the proper place.

The date of *Sārṅgadhara* can be ascertained with accuracy, as besides this medical compendium he is the author of the *Pad-dhati*, a voluminous miscellany, containing, with other matters, a poetical anthology. The author dates his work in *samvat* 1420 or A. D. 1363. The name of the author's father is *Dāmodara* and that of the grandfather *Rāghavadeva*. The latter was highly considered by *Rājā Hammīra*, the Chauhan.*

* After the sack of Chitor by Alla-ud-din in A. D. 1303, Mewar was occupied by the garrisons of Delhi. Hammīra

There is a big commentary on this work by A'dhamalla, whose ancestors settled in the city founded by Hammira.*

Rasendrasārasaṅgraha : The author, Gopālakṛishṇa, begins by admitting that his treatise is a mere compilation based upon many Tantras, though he mentions by name only two, namely, Rasamañjarī and Chandrikā. Special stress is laid on the therapeu-

recovered his ancestral throne and during his prosperous rule of sixty-four years (1301-1365) and that of his successors arts and literature found liberal patrons (vide Tod's "Annals of Rājastan"). The court of Hammira attracted another distinguished physician named Saugata Siṃha as we gather from the colophon to a noted receipt,

एषः योगहर्षिद्वयकविपूजा लोके प्रकाशोद्भवा
हर्षोदाय मदीमुज्जे * हर्षोदयान्ते मृगम् ।

* A'dhamalla gives an account of his family. His Grandfather was one Chakrapāni, not to be confounded with the celebrated medical author of Bengal (Vol. I, Intro. liv) and he himself was attached to the court of a ruler named, Jaitrasīṃha, whose capital Hāstikāntapuri was situated on the river Charnanvati. We reproduce in the next page the text which is somewhat corrupt from the copy preserved in the Library of the Sanskrit College, Benares.

tic efficacy of mineral preparations.* Like Rasendrachintāmāxi it assigns a minor place to the ancient Ayurvedic method of treatment by kashāyayoga, i. e., by herbs and simples; as far as the knowledge of chemical processes goes, it must be held inferior to the former. Numerous medicinal recipes

श्रीवाक्यकुलवकासमन्त्री ये पूर्वजा विभुताः
 श्रीहृन्मोरपुरे * * * * *
 तदन्वये किं बहुना प्रसिद्धीयकपाणिः कुलकेरवेभ्यः (न्दुः)
 * * * * *
 तस्य बुद्धिसुमनस्य तदानीं भावसिद्ध इति सूचयिष्याम्यः ।
 * * * * *
 तस्मात्तन्नी दीर्घमति पञ्चदो नासादमन्त्री * *
 तेन * * श्रीमाखले (?) (विनाखले) मार्गभरकामः ।
 ह्यानीकालपुरी पुरा पुरजिता काशीन विद्वन्मने-
 र्यामा यत्र सरःसरिद्वयवरा चर्मोत्तरी प्रापका ।
 यस्यां उद्वतवासुदेवचरसदृशान्भुजः आपतिः
 स्याती धर्मदवाणि धर्मवतिषु श्रीमैत्रसिंहः प्रभुः ॥
 तस्यां मार्गभरोक्तानां श्रीमानां च प्रकाशितौ ।
 क्षिपते सादमहेन संक्षिप्यायाः प्रदीपिका ॥

* For a description of some of these vide "Journal des Savants," April, 1896.

agreed word for word with those in Rasendra-
chintāmaṇi, which only proves that both have
drawn on a common stock. There is no
question of the one borrowing from the other,
as internal evidence proves that both belong
to the same period. Abhayānanda Gupta in
the preface to his edition says :—"There is a
tradition to the effect that Gopāla Kavibhū-
shana of Dakshina Vāṅga is the compiler of
this book ; but this can scarcely be accepted
as he lived not long ago." Again, "Its com-
mentator, Rāmasena Kavindramāṇi (author
of Arthabodhikā), was court physician to
Nawāb Jaffer Ali Khan of Bengal (Mir Jaffer)
some 200 years ago." Rāmasena himself
quotes from 3 commentaries of this book ;
hence it was recognised as of some degree
of importance at that time and must have
been composed long before. This work is
very popular in Bengal and is a *vade mecum*
of the local Kaviṛājas.

Rasendrakaḷpadrūpa is another work of
this period. It deals chiefly with mineral
preparations and is a mere compilation from

Rasāruṇava, Rasamaṅgala, Ratnākara, Rasāmṛita and Rasaratnasamuchchaya ; the numerous citations with which it is replete are of some use in correcting many doubtful readings in these latter. Our MS. is incomplete, the first few couplets and the sequel being lost ; for the opening lines of the work see Aufrecht's Catalogue of the Bodleian Library, MSS., pt. 1, p. 321.

Dhāturatnamālā : This epitome is devoted exclusively to short processes of *killing* metals and minerals. Six metals are recognised at the outset, namely, gold, silver, copper, lead, tin and iron as in the ancient works; but strange to say later on *kharspara*,* which is the mineral calamine, is taken as synonymous with *jasada* or zinc. We have before us a MS. procured from Benares. It is full of corrupt readings. The copy noticed in the Bodleian Library Catalogue seems to be more correct. From the colophon in the latter we learn that the author is one Devadatta of Gujarāta, but in the Benares exemplar

* Vol. i. p. 158.

this portion has been coolly tampered with, so that this poor compilation may be palmed off as an integral part of a *Saṃhitā* of the *Aśvin(kumāras)*, the divine physicians, and thus entitled to the respect due to revelation. This work cannot be placed earlier than in the 14th century. Here we have a serious side-light into the history of literary forgeries.



CHAPTER IV.
MODERN PERIOD.
1500—1600 A. D.

We have now arrived at what may be termed the modern period in Hindu chemistry and materia medica. The characteristic of this period is that over and above opium, we have some other foreign drugs incorporated into the materia medica. By the beginning of the 16th century A. D. the Portuguese had fairly established themselves at Goa and some other parts of India,* and as a result of intercourse with them, that dreadful scourge—the venereal disease—had made its appearance. Sanskrit medical treatises from the Charaka and Susruta downwards and ending with Śārṅgadhara are silent about this malady though they give fairly

* The political influence of the Portuguese as early as 1533 A. D. is evident from the fact that Sultan Bahadur, king of Gujardā, entered into a treaty with them and through their assistance raised a force of 6,000 Abyssinians—"Memoirs of Humayun".

accurate descriptions of diseases of the genital organs (उपदंष्ट्र). But syphilis had now to be reckoned with and a new name had to be coined for it. Accordingly we find *Rasa-pradīpa*, one of the standard works of this period given to Tantric method of treatment, prescribing calomel and *chobchini* (China root, *Smilax China*, Linn) for what is now termed for the first time *Phivangaroga* or the disease of the Portuguese. According to Flückiger and Hanbury "the use of this drug as a remedy for syphilis was made known to the Portuguese at Goa by Chinese traders about A. D. 1535." Thus from an independent source we can arrive at the approximate date of *Rasapradīpa*. This work also gives us a detailed process for the preparation of mineral acids by distillation which is here termed *samkha-drāvaka* (lit. a solvent for conch shells) and is described as "endowed with the property of dissolving metals." It is thus evident that the use of mineral acids as a solvent for metals was unknown in India before this time.* A very

* *Flückiger's Note on mineral acids*, vol. i. p. 185.

noteworthy circumstance in connection with this is that the Bhāvaprakāsa, which is posterior to Rasapradīpa, is silent about *saṃkhaḍṛgṛvaka*, which had come to be prescribed by this time as a favorite remedy for indigestion and derangement of liver and spleen; the solvents being borax, treacle, etc.—(cf. vol. i, p. 130). In the Bhāvaprakāsa among the acids we have only the juices of acid fruits. This is only another instance of the danger one is liable to incur by drawing inferences from *argumentum ex silentio*.

Rasakaumudī is another compilation belonging to this period and as far as its contents go it is comparable to Rasapradīpa in many respects; both opium and mineral acids are prescribed. From the colophon in the Calcutta Sanskrit College Library MS. we gather that the author is a physician named Mādhava. Curiously enough he is often confounded with the celebrated Mādha-vakara, the author of the Nidānasamgraha, who preceded the former by some 8 or 9 hundred years.

The next work which should now claim our attention is the well known Bhāvaprakāśa of Bhāvamisra. It is a voluminous compilation in which the Ayurvedic method of treatment has been mainly adopted and as such ample citations are given from the Charaka, Susruta, Vāgbhata, Hārīta, Vrinda and Chakrapāṇi. But the Tantric remedies could not altogether be given a wide berth and accordingly one or two chapters have been devoted to mineral preparations; but these have been borrowed chiefly from Rasapradīpa, Rasendrachintāmaṇi, Sārngadhara and other standard works. Bhāvamisra has been scrupulously candid in his acknowledgments to the various authorities quoted by him. *Phirangaroga* is mentioned as also its treatment with the help of calomel and *chobchini*. The author lived about the time of the Emperor Akbar and evidently in that part of India which is now known as the United Provinces and it is not to be wondered at that Mussulman influence is discernible in his book.

We conclude our survey of this period

with the notice of a remarkable production entitled *Dhātukriyā* or “operations with metals”; it is in the shape of a dialogue between *Siva* and *pārvati*; in short, it pretends to be a part and parcel of the *Rudrayāmala Tantra*.* The work cannot be placed earlier than in the 16th century A.D., as it contains reference to the country of the *Phirangas* and to *Rūma*, the Arabic name for Constantinople. For the first time we come across the very appropriate term *dāhaja* (lit. burning water) coined to denote sulphuric acid. The information about the metals is of very meagre and poor description and it has been needlessly spun into an inordinate length. The author evidently considers it a pious fraud to make such statements as follow emanate from the mouth of *Siva* himself:—

“By using coins made of imitation gold one can carry on exchange . . . and thus enrich oneself.”

* We have in hand transcripts of two MSS.—one from the Library of the Mahārājā of Ulwar, the other named somewhat differently, *Dhātumālījari*, from Benares. They agree very closely.

The curious reader who is referred to the translations of the selected portions of the text given elsewhere will not fail to recollect similar passages in the Leyden Parchment where the dishonest goldsmith gives numerous recipes for "augmenting gold." * Fraudulent attempts in the direction of palming off alloys of base metals, possessing bright, yellow lustre, for gold, have been made in all ages and in all climes (*cf.* extracts from *Rasārṇava*, Vol. i, p. 74).

Arkaprakāśa or a treatise on the preparation of medicinal tinctures and essences should also find a place here; † its authorship is ascribed to Rāvana, the mythical king of Ceylon. The contents of the work, however, reveal its date. For instance, mercury, treated with S'amkhaḍrāvaka, is prescribed as the remedy for "Phiraṅgaroga" (syphilis).

* Berthelot: "Collection des Alchimistes grecs" (trad. p. 287). "La Chimie au Moyen Âge," T. i. p. 31.

† There is a Calcutta edition published by Gayesa Chandra Ghoshā; we have compared it with a MS. procured from the Sanskrit College, Benares. They agree remarkably well.

Opium also is prescribed ; while the term yasada is used to indicate zinc. As a distilling apparatus a tinned copper vessel is recommended. Mahommedan influence is distinctly discernible in this hybrid production. The very title of the book is no doubt Sanskritised from the Persian *arrak* (essence).

It is unnecessary to proceed further. We have before us the MSS. of Rasamañjari by Śālinātha, of Rasarañjana, of Gandhaka-kalpa (a Tantra), of Rasāraṇaya (quite distinct from the standard work bearing the same title), of Rasaratnākara (altogether different from that of Nityanātha) and several others. As all of these repeat *ad nauseam* the processes already described, we refrain from examining their contents here.

CHAPTER V.

INDIGENOUS ORIGIN OF INDIAN ALCHEMY.

The reader who has been able to follow us throughout with patience will not have been slow to recognise that alchemy in India has been developed all along on independent lines. Its origin and growth are interwoven with a phase of religious activity—the outcome of purely indigenous traits—which has been discussed at length in chapter i.

The only instance in which we find some allusion to adepts outside the pale of Hindu institutions occurs in *Rasaratnasamuchchaya*.^{*} But the term *Mlechchha* used there is a generic one applied indiscriminately to

^{*} मेघनदकावधान्. *Vide* Vol. i, Sans. text, p. 50; a var. not in the Poona edition has मेघनदकावधान्, which must be rejected as both the Benares and Kāmtr MSS. accept the former.

the Sakas, the Yavanas (Greeks or Bactrians), the Chīnas (Chinese), etc. The Hindus have never been shy of acknowledging their obligations to the Yavanas; Varāhamihira for instance expresses his admiration for the proficiency of the latter in the field of astronomy and would gladly learn at their feet.* In the Mahābhārata again we find the services of the Yavana architect, Purochana, requisitioned. We have not, however, come across a single passage, which may be construed into implying a hint to alchemists in the West. That the term Mlechchha in R.R.S. really refers to the Kirātas is evident from the colophon to Rasahridaya. †

Those scholars who have hitherto maintained that Indian alchemy is of exotic origin, have, we are afraid, done so on *a priori*

* किराता वि दण्डनास्तेषु सन्त्यक् प्राकृतमिदं स्थितं ।
स्वधिवसेदपि पुन्यत्वे किं पुनर्देवविहिताः ॥

† Sans. texts, p. 39; there the four castes (चतुर्वर्ण) are distinctly mentioned and the kirātas evidently included under the Mlechchhas.

grounds. Indeed the frame of mind which they have brought to bear upon this subject is not calculated to lead to a judicial and dispassionate verdict. The fact that the Hindus are indebted to the Greeks for substantial improvements in their astronomy is too often urged whenever it is necessary to support such a view.* There is, however, very little affinity in the mode of growth of alchemy in India and of its *congener* in the West. The progress of magic, witchcraft and alchemy can be traced from the Atharva.

* *C*.—"It was, however, Greek influence that first infused a real life into Indian astronomy. This occupies a much more important position in relation to it than has hitherto been supposed; and the fact that this is so, *eo ipso* implies that Greek influence affected other branches of literature as well, even though we may be unable at present directly to trace it elsewhere." Weber: *Hist. Indian. Lit.* ed. 1892, p. 251. In justice to Weber, however, we should quote here his views on the independent origin of Hindu medicine; namely, "the weights and measures to be used by the physician are expressly enjoined to be either those employed in Magadha or those current in Kalinga; whence we may fairly presume that it was in those eastern provinces, which never come into close contact with the Greeks, that medicine received its special cultivation."—p. 269.

vedas onwards to the later Tantras according to the laws of evolution without any breach of continuity.

One of the most favourite doctrines of the neo-Platonists was that the metals were engendered in the womb of the earth under the influence of the planets. According to Olympiodorus (5th century A. D.) lead is begotten by Saturn, "electrum"* by Jupiter, iron by Mars, copper by Venus, tin by Hermes, gold by the Sun and silver by the Moon. † Now, such a fascinating astrological belief was pre-eminently calculated to appeal to the Hindu instinct, especially as there was a "commercial and lively intellectual intercourse," to quote Weber's own words, between Alexandria and the West Coast of India. Varāhamihira's *Vṛhatsam-*

* An alloy of gold and silver was known by this name. Later on it disappeared from the list of metals, tin being assigned to Jupiter, and mercury to Hermes.

† The influence of the astral bodies on the production of the metals can be traced to Proclus' commentary on the *Timæus*.—Berthelot: "*Les origines de l'Alchimie*:" p. 49; also *Coll. des. Alch. Grecs. trad.* p. 100.

hitā, if anything, is a repertory of astrological notions. In vain do we look even there for any such chance and solitary reference.* The alchemical literature of India is equally silent about it. † True it is there are two metals which are often designated as the sun and the moon respectively, namely copper

* Chapter xvi of this work treats of "countries, people and things belonging to the domain of each planet." Among sundry other things "the Sun is the lord of gold and fire." Thousand and one articles are said to be presided over by the Moon, Mars, Mercury, Jupiter, Saturn, Venus, Rāhu and Keta; but nowhere is there any connection between the planets and the metals. *Vide* Kern's trans., pp. 97—101.

† The mythical origin of some metals is given in the Purāṇas; but no reference to the astral bodies is to be found. Thus silver originated from the tears of the God Siva, copper from the semen of the God Kārtikeya, lead from the semen of the Snake God Vāsuki, iron from the different parts of the body of the demons called Lomilas; and gold from the semen of the God of fire. Some vague and remote connection only can be established between this sort of nomenclature and that of the old Greco-Egyptian alchemists. According to the latter mercury is sometimes designated as the semen of Hermes; whilst in the Tantras it is the semen of Siva (इश्वरोज्ज). *Vide* "Intro. à l'étude de la chimie des anciens," p. 11.

and silver.* But this has nothing to do with the planetary generation of these metals. In the imagery of the Sanskrit poet the crimson tint of the rising sun and the pale white lustre of the moon are comparable to the colour of copper and silver respectively.

The old Greek writers repeatedly refer to the mystic relationship between the seven planets and the seven metals. In the Sanskrit literature, however, beginning with the *Susruta* and coming onwards to *Rasaratna-samuchchaya*, we invariably find six metals recognised, alloys being rigorously excluded from the list and regarded simply as "artificially made." † It is only in the *Sārṅga-dhara* and other later works that we find seven metals enumerated ; ‡ but this author

* रतन, चक्रे and other synonyms are as a rule applied to copper but rarely to gold.

† *Vide* Vol. I, pp. 48, 72 and 127.

‡ (चाक) brass being taken as the additional metal ; zinc was evidently unknown to *Sārṅga-dhara*.

सर्वद्वाराद्वाराणि नामवर्गी च दीप्तकम् ।

चाकः सप्त विदेहाः ।

is guilty of a curious inconsistency, since in a subsequent part of his book he adds two more to the list and quietly lays down that there are nine metals, *which derive their names from the nine planets*.^{*} This may be read as a sort of vague and indistinct connection between the metals and the astral bodies.

The Arabs who adepted many of the Greek doctrines of alchemy also represented the seven metals by the seven planets. In fact it was through the medium of the Arabs

^{*} "Kāmsya" (bell-metal) and "Vartaloḥa" or "Var-taloḥa" (*cf.*—Vol. i. p. 114) make up the number. Rāhu and Ketu are the two mythical planets; they are in reality the ascending and descending nodes in the ecliptic. Rāhu is supposed to cause the eclipse of the sun and the moon by swallowing it up.

Sārngadhara stops here, but his prolix commentator, A'dāmaṇḍa supplies the deficiency by making copper stand for the Sun, silver for the Moon, brass for the Mars, iron for Saturn, gold for Jupiter, tin for Venus, lead for Mercury and bell-metal and vartaloḥa for Rāhu and Ketu respectively.

It will also be noticed that lead is here represented by Mercury; but in the Hindu alchemy mercury always stands as the visible manifestation of the God Śiva, it being generated from his semen, hence the name दसवीन given to it.

and the Jews that a knowledge of the Greek sciences including alchemy filtered to the European nations during the middle ages.* We have already seen that Rájputána had been overrun and even occupied for a brief period by the Mussulman conquerors shortly before the time of Śárágadhara and it is reasonable to suppose that he had gleaned some astrological notions from that quarter.

We now advert for a moment to the main question of the connection of the comparatively modern and scientific phase of Hindu astronomy with the science of Alexandria. Although it is admitted by all those who are entitled to speak with authority on the subject that the Hindus borrowed from the Greeks and thus improved upon their older system, many points have yet to be cleared up. Professor Whitney who has

* "C'est par l'intermédiaire des écrits arabes et hébreux que la plupart des connaissances scientifiques des Grecs en mathématiques, en astronomie, en physique et en médecine, ont été transmises au moyen âge occidental; les écrits Grecs proprement dits n'ayant guère été connus directement avant la Renaissance."—"La chimie au Moyen Âge," T. i. p. 229.

carefully studied the subject is struck with the circumstance that the *Sūryya* and other *Siddhāntas* bear resemblance to the system of Hipparchus rather than that in the *Syntaxis*.* In other words the transmittance of astronomical knowledge must have taken place before the time of Ptolemy. Now the period of lively intercourse is precisely that covered by the age of Ptolemy and that of his followers, and yet the Indian astronomers seem to be unaware of his teachings.†

* Intro. to "*Sūryyasiddhānta*". We find from Ptolemy that the observations of Hipparchus extended from B. C. 162 to B. C. 127. Ptolemy flourished at Alexandria in the second century A. D., under the reigns of Adrian and Marcus Aurelius.

This was also pointed out long ago by Colebrooke, e. g. "The whole cluster of astronomers mentioned by Brahmi Gupta must be placed in the interval between the age of Hipparchus, and possibly that of Ptolemy."—*Essays*, pp. 411—412.

+ *Aryabhaṭa* composed his treatise "*Laghrīryabhaṭṭi-yam*," in 496 A. D., and *Varāhamihira* his "*Pāṣṇasiddhāntikā*" about 550 A. D. But these astronomers borrowed from the much older treatise entitled "*Romakasiddhānta*" ascribed to *Syriacus*, and *Paulinisiddhānta* (*vide* Thibaut's Intro. to *Pāṣṇasiddhāntikā*, xivii—xivvi).

This mystery has never been elucidated ; Dr. Thibaut's arguments are ingenious, but, we are afraid, by no means convincing.* Indeed in the purely mathematical sciences the Hindus far excelled the Greeks of the Alexandrian school. A'ryabhatta's knowledge of algebra was superior to that of Diophantus and as for arithmetic it is generally acknowledged to be of Indian origin.†

The last word on the subject has yet to be said and it is doubtful if this dark recess will ever be illumined. In the meantime it would be better to hold our judgment in abeyance. At best we can only launch into hypotheses

* *L. c.*, pp. li and liii.

† *Cf.*—Colebrooke : "Admitting the Hindu and Alexandrian authors to be nearly equally ancient, it must be conceded in favour of the Indian algebraist, that he was more advanced in the same."—*Essays*, ii, 429. Again, "in the whole science he [Diophantus] is very far behind the Hindu writers," *ibid.*, p. 438.

Kaye has recently questioned the priority of the claims of the Hindus : *Vide J. A. S. B.* iii [N. S.], July, 1907.

or indulge in dogmatic assertions.*

* One who approaches this subject should divest himself of prepossessions or the "bias of patriotism" as Herbert Spencer puts it. A very agreeable feature in this controversy is that those who are most competent to speak with authority are extremely modest, nay diffident in giving expression to their views. Woepcke in his masterly memoir "on the propagation of the Indian numeral symbols" says:—"La solution parfaite de ces problèmes ne résulterait que d'une connaissance tellement complète des événements et de leurs phases, qu'il faut à peu près renoncer à jamais l'obtenir. D'un autre côté, remplir les vides par des hypothèses arbitraires ou préconçues serait livrer l'histoire des sciences aux hasards et au dogmatisme des inspirations individuelles." "*Journal Asiatique*" (1863).

Lassen whose modesty is only equalled by his profound scholarship observes—*Es wäre sehr wünschenswerth, dass ein mit der gehörigen Kenntniss der Sanskritsprache ausgerüsteter Kenner der Mathematik und Astronomie es unternähme, aus diesen vorhandenen Hilfsmitteln die Lücken unserer Kenntniss auf diesem Gebiet des Indischen Alterthums auszufüllen; für jetzt müssen wir uns darauf beschränken, die hauptsächlichsten Ergebnisse der bisherigen Untersuchungen zusammenzustellen.*" "*Indische Alterthumskunde.*" Vol. ii. p. 1150; ed. 1874.

CHAPTER VI.

SOME NOTED INDIAN ALCHEMISTS AND THEIR WORKS.

Aufrecht in his notice of the MS. of *Rasaratnasamuchchaya*,* evidently from a mistaken notion that the pursuit of chemistry was unknown in ancient India, goes somewhat out of his way in asserting that the names of the 27 alchemists, mentioned in the beginning of that work,† are mostly apocryphal. We have, however, positive proofs that these personages far from being evolved out of the imagination of the author existed in real flesh and blood and contributed not a little to the progress of chemical science. Thus we read in *Rasaratnākara* of “chemical operations performed by *Māṇḍavya*” and also find *Ratnaghosha* taking part in a dialogue on certain processes, ‡ *Yasodhara*, again, is the author of the comprehensive work named *Rasaprakāśasudhākara*

* *Catalogue Catalogorum*, ii. p. 116.

† *Ibid.* Vol. i, p. 77.

‡ *Eng. trans.* pp. 6–8.

which we have noticed at some length in the present volume. Vyādi is a prominent name both as a grammarian as well as a chemist. The *Garuḍapūraṣa* quotes him as an authority on gems.* Nandī, as we have already seen, is distinctly referred to by Somadeva as the inventor of the *koṣṭhī* apparatus and of the process of sublimation. †

There are, indeed, a great many names scattered throughout the mass of chemical and medical literature, some of which have been handed down to posterity, sometimes on account of the important processes they invented and sometimes, again, because of the efficacy of the metallic preparations which they introduced. Thus in *Rasendra-chintāmaṇi* we come across the name of Siddha Lakshmiśvara. The names of the sage Brahmajyoti, Manthānabhairava, Svachchhandabhairava and Gahanānandanātha have in this manner been rescued from oblivion. Most of these were Buddhist monks.

* आकृतिगद् दगता हि मन्दादनामः सिद्धी सिद्धादित्तुल्ययो दगताः ।
Intro., 1c.

Sivadāsa in his commentary on Chakrapāṇi quotes besides Patañjali, Bhavyadattadeva as an expert on iron preparations. We give below the names of some of the authors and their works over and above those already noticed. It is scarcely possible to submit an exhaustive list.

Name of the Author.	Name of the work.
Anandānubhava	Rasadīpikā.
Balabhadra	(Unknown).
Bhojadeva	Rasarājamṛigāṅka.
Chandrasena	Rasachandrodaya
Charpata	Charpatasiddhānta.
Dhanapati	Divyarasendrasāra.
Garudadattasiddha	Rasaratnāvali.
Gorakshanātha	Gorakshasamhitā.
(Unknown)	Bauddhasarvasva.
(Unknown)	Rasesvarasiddhānta.
Harihara	Rasavisvadarpana.
Kaṅkāli	Rasakaṅkāli
Kopāli	Rasarājamahodadhi.
Kṛṣṇadeva	Yogaratanākara.
Mallāri	Rasakantuka.
Narahari	Rasayogamuktāvali.
Rāmarāja	Rasaratnopradīpa.
(Siddha) Bhāskara	Rasendrabhāskara.
(Siddha) Prāṇanātha	Rasadīpa.
Śrīnātha	Rasaratna.
Trimallabhatta	Rasadarpana.
Vaidyārāja	Rasakāshāyavaidyaka.
Vandimīra	Yogasudhānidhi
Vāsudeva	Rasasarvesvara.

The Tantric Period

(Continued).

Chemistry in Rasaratnākara of Nāgarjuna.

[In the rendering of Rasaratnākara of Nāgarjuna and other Sanskrit texts we have often given only free translations. Such passages as are unnecessary repetitions or are not of sufficient interest to the general student of the history of Chemistry have been left out.]

CHAPTER I.

I shall now speak of the purification of the important rasas* (minerals).

What wonder is it that rājāvarta digested with the juice of *Acacia sirisa* converts silver of the weight of one guṇja into one hundred times its weight of gold of the lustre of the rising sun ? 1

* Regarding rasas see Vol. I, p. 79.

What wonder is it that yellow sulphur, purified with the juice of *Butea frondosa*, converts silver into gold when roasted thrice over the fire of cowdung cakes † 2

What wonder is it that calamine.....roasted thrice with copper converts the latter into gold ‡ 3

* These laconic recipes all refer to the floating mass of traditions current at the time of the author on the transmutation of the base metals into gold. As they are of a fragmentary and disjointed character, the meaning is not always clear. Recipe 3 also occurs in *Rasārṇava*; vide Vol. i, pp. 70-71. Various ingenious methods were resorted to for debasing gold or making an alloy, which would mimic the appearance of this metal. Silver, copper, lead, zinc and mercury were often made into an amalgam, and the latter rendered compact and coloured yellow with the aid of orpiment. No wonder that the law-books prescribe several penalties on the fraudulent debasers of the precious metals. Thus according to *Manu* "the king shall cause a goldsmith, who behaves dishonestly, the most noxious of all the thorns, to be cut to pieces with razors." IX, 292.

The reader who feels interest in this subject may consult Berthelot's "*La Chimie au moyen âge*," t. i. pp. 31 *et seq.*, where will be found several recipes for augmenting gold *aureum plurimum facere*, or for the "fabrication of gold." One example may be cited here. "Take gold, copper and mercury, make an amalgam of the whole, afterwards add sulphur, orpiment, "sandarac" (a kind of resin) and the bile of the vulture &c." The author of the recipe thus concludes:—"Thou wilt now discover a secret, which is sacred and worthy of praise" (l. c. p. 35).

What wonder is it that cinnabar digested several times with the milk of the ewe and the acids* imparts to silver the lustre of gold glowing as saffron † 4

Digestion [of minerals] is to be effected in the decoction of *Dolichos uniflorus*, *Paspalum scrobiculatum*, the urine of man and the acid juices of [the fruit of] ratan (*Calamus rotang*) and afterwards with the addition of the alkalies (soda, borax &c.) The operation of roasting is to be performed thrice.—Cf. the process of *Rasaratnasamuchchaya* (R. R. S.), Bk. ii, 67-68 in Vol. i, p. 82.

What wonder is it that the pyrites macerated in the juice of *Musa sapientum* and in castor oil and clarified butter, and placed inside the bulb of *Arum campanulatum* and roasted [in a closed crucible] undergoes perfect purification ‡ 4

Chapala and other minerals, being macerated in the juice of the lemon for 3 days, become purified. Gold being smeared with the 5 earths, the ashes and salts † and roasted, undergoes purification. 12.

* Vegetable acids are meant here. *Vide* Vol. i, p. 128.

† Here extraction of copper from the pyrites is no doubt meant. Cf. R. R. S. Bk. ii, 89-90; *vide* Vol. i, p. 84.

‡ Cf. R. R. S. Bk. i, 71, 85; *vide* Vol. i, pp. 128-129.

Silver alloyed with lead and fused with ashes becomes purified.* 13

Lo | it is not to be wondered at that copper, melted with the alkali derived from the earth† and the milk of the ewe, clarified butter and one-sixteenth of its weight of oil, will become pure like the crescent of the moon. 14.

Verses 23-25 : Extraction of the essence of vaikrānta : exactly the same as in R. R. S. Bk. ii, 71-72. *Vide* Vol. i, pp. 83-84.

Verses 25-30 : Have reference to the extraction of copper from māksika and tāpya (varieties of the pyrites). They agree in all essentials with Rasārnava, Ch. VII, 12-13. *Vide* Vol. i, p. 70

Verses 31-32 : Extraction of zinc from calamine. Cf. R. R. S. Bk. ii, 163-164. *Vide* Vol. i, p. 88.

Verses 35-36 : Exactly the same as in R. R. S. Bk. ii, 103-104. *Vide* Vol. i, p. 85.

Verses 37 : Essence of darada, i. e. extraction of mercury from cinnabar by distillation. Cf. R. R. S. Bk. i, 89-90. *Vide* Vol. i, p. 78.

* Refers to cupellation. Cf. Rasārnava in Vol. i, p. 68, footnote (1).

† इषिनीनवेन चारेण may refer to natron or to saltpetre.

Verses 50-51 : Dissolution of gems (pearls &c.) by digestion in vegetable acids, *e. g.* sour gruel (impure vinegar) and the juice of certain acid plants.

* * * *

Here ends Chapter Second of Rasaratnākara by Nāgārjuna on the *killing* of diamond and the metals, extraction of the essence of minerals and liquefaction of mica.

CHAPTER III.

I shall now explain [the process of] fixation of mercury. The king of rasas (mercury), rubbed with the juice of lime, sal-ammoniac, the acids, the alkalis, the 5 salts, *Piper nigrum*, *P. longum*, the dried root of ginger, the juice of *Moringa pter.*, the tuber of *Amorphophallus campanulatus*, can readily amalgamate itself with the 8 metals. 1

* * * *

Prajñāpāramitā (perfection of wisdom) appeared before Nāgārjuna at midnight in a dream and revealed to him the ingredients of a recipe (consisting of steel, copper, mica, pyrites, &c.) 4

Mercury is to be rubbed with its equal weight of gold and then [the amalgam] further admixed with

sulphur, borax &c. The mixture is then to be transferred to a crucible and its lid put on and then submitted to gentle roasting. By partaking of this elixir (*i. e.* the sublimate) the devotee acquires a body not liable to decay. 30-32

I shall now describe the Garbha yantram.* 62-65

Recipe for Kajjali or ethiops mineral.† 84-86

* * * *

Having made salutation to all the Buddhas, free from the taint of sins, I shall now deliver the Kakshaputa tantram ‡ for the benefit of suffering humanity.

[The most important part, from an historical point of view, is the dialogue between Nāgārjuna, King Śālivāhana and Ratnaghosha.]

Nāgārjuna, whose end (salvation) had been attained, benevolent towards all living creatures, blessed with all favours, residing on mount Śrinaila, before him stood Ratnaghosha with folded arms,

* The same as in Rasāmrta. *Vide* Vol. i, p. 56.

† The process is practically the same as in Chakrapāni; *vide* Vol. i, p. 58.

‡ There is extant a Tantra, which goes by this name, the reputed author of which is Nāgārjuna.

saying : "Be pleased to communicate to me knowledge on chemical operations."

Nāgārjuna said :—

Well done ! well done ! I am pleased with your devotion and shall convey to you all that you want to know, namely remedies for warding off wrinkles, grey hair and other signs of old age. Mineral preparations act with equal efficacy on the metals as on the body (human system). *

* * * *

For the benefit of living beings I went through all manner of penances for 12 tedious years and worshipped the goddess Yakshini presiding over the *Ficus religiosa*. Then I heard an oracle.

Nāgārjuna said :—

O Goddess ! if thou art propitiated, be pleased to communicate to me the rare knowledge of the fixation of mercury.

* * * *

Sālivāhana said :—

I have dedicated to thee, O Goddess ! treasures of gold and gems, now I await thy instructions.

* This was a favourite metaphor with the alchemists. Cf. Vol. I, Intro. lxxvi.

The Goddess said :—

Well done ! well done ! O wise ruler ! I shall speak to you of chemical operations performed by Māṇḍavya.* ... A disciple should be intelligent, devoted to work, sinless, and master of his passions. †

The apparatus known as *koṣṭhī*, mouth blow-pipe, cow-dung, substantial wood (as fuel), a pair of bellows, iron plates, * * * having collected all these, chemical operations are to be performed.‡

* * * * *

Ratnaghoshā said :—

Having prepared with great care "the powder of projection," which transforms a ten million times its weight of the base metal into gold, § * * *

Nāgārjuna said :—

I shall convey to you what has been experimented upon by Sākāṇḍa. ¶

* * * * *

* A well-known alchemist ; one of the 27 adepts mentioned in the opening lines of R. R. S. *Vide* Vol. i, p. 77.

† Cf. "Initiation into discipleship" in Vol. i, p. 115.

‡ Cf. Rasārṇava in Vol. i, pp. 64-65.

§ कोटिबिंबो मङ्गलम्—the term *बिंब* has technical meaning. Cf. Vol. i, p. 120.

¶ We are unfamiliar with this name, probably the reading is corrupt.

Tests for *killed* mercury.

The first two complete are almost the same as in Rasānuṣa. Cf. Vol. i, p. 74.

When the quicksilver, which has acquired the colour and the lustre of the rising sun, stands the test of fire (*i. e.* is not readily volatilised), then it is to be regarded as *fixed*.

Here follows a list of apparatus borrowed from Rasendramangala—Detailed account of most of these will be found in R. R. S. Bk. ix. *Vide* Vol. i, p. 67.

Chemistry in Rasahridaya of Bhikshu Govinda.

Quicksilver digested with sour gruel and then subjected to distillation is freed from [the impurities of] lead and tin. 1

Much the same as above. 2 * * *

Description of the apparatus for purification of mercury by sublimation and distillation: it agrees almost literally with that given in R. R. S. Bk. ix, 6, 8. *Vide* Vol. i, p. 121.

Patala vii.

Ingredients for making a *vida* for killing metals. Cf. Rasārṇava, IX, 2-3. *Vide* Vol. i, p. 72.

Preparation of mild alkali from the ashes of plants :—

The process must be considered as a poor one compared to the elaborate description in *Susruta* Cf. Vol. i, p. 32.

Patala viii.

* * * Alum, blue vitriol :—all these severally or collectively are favourable for imparting colour to quicksilver.*

Experts [on the properties] of metals are of opinion that tin gives strength, tikkṣṇa colour, lead unctuousness, copper all these qualities [to mercury.]

Couplets (in p. 29, Sans. text): The purport seems to be that when mercury is rubbed with certain sulphides, e. g. orpiment, pyrites &c., and sub-

* The text is not very intelligible. The other ingredients mentioned are tikkṣṇa and kṣāṇṭa, these being varieties of iron; but iron will not amalgamate with mercury. Tikkṣṇa may also mean a kind of saline earth. The old alchemists racked their brains in devising ingenious processes for robbing mercury of its fluidity and imparting to it various colours. Cf. Rasārṇava, IX, 2-3, XI, 197-198. *Vide* Vol. i, p. 74 and also "The Hindu method of manufacturing calomel,"—*ibid.* p. 250.

lined, it assumes the colour of lac or *Coccinella* insect (a poetical and figurative way of expression for red colour) in the shape of the red crystalline sulphide.

Pātala ix.

Vaīkrānta, kānta, sasyaka, māksika, vimala, adri, darada, rasaka :—these are the 8 rasas* and their essences are well suited for chemical operations.

Sulphur, gairika, kabīti, khechara (mica), añjana, kankuśā :—these are the uparasas. Cf. Vol. i, p. 89.

Gold and silver are the *noble* metals.

Copper, brass, īkshva and kānta (varieties of iron) are the essential or substantial metals; lead and tin emit fetid odours. Cf. Vol. i, p. 113, footnote (1).

The six salts are :—Sauvarehala, saindhava, chūlika (sal-ammoniac), sāmadra, romaka and vīḍa. The alkalies are :—Sarjikākshāra, yavakshāra and borax. (*Vide* Vol. i, Index of subjects.)

Pātala xi.

A cupel made of boneash (goat's) and lined internally with borax &c.

* Cf. Vol. i, pp. 79-81.

Colophon giving an account of the author :—

Madanaratha, King of Kirāta, teacher of mercurial lore, in whom the Goddess of the science of mercury and minerals (Chemistry), the source of all good, has taken her abode for the benefit of mankind, who can restore to the disfigured patient, afflicted with leprosy, the healthy comeliness and lustre of youth :

Bhikshu Govinda, well versed in chemical operations and loaded with honours by the King of Kirāta, composed this tantra entitled "Rasahridaya."

This tantra is written by Govinda, the grandson of Maṅgalaviṣṇu and son of Sumanaviṣṇu :—
May Tathāgata pronounce his blessings.

Chemistry in Kakachandesvari- mata Tantra.

Paṭala i.

The first paṭala gives the origin (mythical) of the tantra.

Paṭala ii.

Kakachandesvari said :—

* * * Please, give a brief account of the

Chemistry of the metals, the killing of mercury and minerals and the fusion of the gems. 3 4

Sri Bhairava said :—

* * * Mercury rubbed with the ingredients of the *vīṭa* (see Vol. i, p. 72) and roasted in a closed crucible, is killed instantly. That mercury now acquires the power of converting a base metal into 1,000 times its weight of gold. 13-16

Copper, treated with the above preparation of mercury and rubbed with the acids, alkalies and the milky juice of *Calotropis gig.*, and roasted in a crucible, turns into gold. 18-20

Earth for making crucibles. 21-22 Cf. Vol. i, pp. 67-68.

Transmutation of iron into gold :—process not clear. 25-32

Paśala iii.

Liquefaction of mica :—

Thin plates of mica are to be smeared with the 3 alkalies and borax and strongly heated in a crucible. The whole mass fuses.* * * * 29-30

* Refractory silicates are treated similarly at the present day with the "fusion mixture."

**Chemistry in Rasendrachudamani
of Somadeva.**

Sans. texts, p. 51.

Tests for killed iron (rouge).

As R. R. S. has borrowed these from the present work, it is unnecessary to repeat them here. *Vide* Vol. i, pp. 118-119.

Sans. texts, pp. 52-53.

Take lead of the weight of 30 palas and rub it with the milky juice of *Calotropis gig.* and calcine it till its weight is reduced to a karsha: this residue, even if it be calcined a thousand times, will not undergo further decay (i.e. diminution in weight). Metallurgists call this residue derived from lead Chapala.*

Tin also similarly treated will yield a chapala, which, on merely being touched with the hand, kills (fixes) mercury. This mercury is recommended for metallurgical and not for chemical purposes.

* Possibly it refers to lead derived from *argentiferous galena*. The lead, being cupelled off in the shape of litharge, will leave a button of silver, which will not undergo oxidation.

Sans. texts, pp. 53- 4.

[A somewhat complex process described, which is not very clear. We shall try to give the purport thereof. The quantitative measurements are of particular interest.]

1 pala of tin should be taken and rubbed with 10 nishkas of mercury and made into a cake with the addition of zinc; it is then to be digested with the decoction of certain herbs and plants and warm vinegar and once more rubbed with $\frac{1}{2}$ pala of blue vitriol † and the juice of *Abrus precatorius*. The mass is then to be divided into small pills; these should then be put into a crucible with the lid on and the fire to be urged by means of bellows. The essence is then to be taken out of the crucible. This essence of the weight of 10 *Sāras* is then to be enclosed in a mixture of ashes and salts and roasted. This essence of the weight of 2 nishkas is then to be fused with 80 times its weight of lead * * *. This (essence) is also termed chapala. Cf. "the gold-like alloy" in Vol. i, pp. 74-75.

* रसयज्ञ सखेन.

† पद्मार्चक सखेन.

Sans. texts, p. 55.

When quicksilver has been deprived of its physical properties (lustre, fluidity &c.) it is known as *nashtapishṭa*. Cf. Vol i, p. 74.

Somadeva will now give a brief account of the apparatuses, after having consulted numerous chemical tantras. (Here follows the description, which has been reproduced *verbatim* in R. R. S. Vide Vol. i, pp. 121 *et seq.*)

* * * *

Urddhvaṇṭana apparatus as described by Nandin. Cf. Vol. i, pp. 124-125.

Koshṭhi apparatus as described by Nandin. Cf. Vol. i, p. 69.

Chemistry in Rasaprakasa- sūdhakara of Yasodhara.

Sans. texts, p. 57.

Preparation of *karpūraṇṭa* (lit. camphor of mercury, i. e. calomel) : practically the same process as given in Vol. i, pp. 250-51.

[Note. Calomel is prescribed here only as an aphrodisiac and a specific for leprosy but not as a remedy for syphilis.]

Sans. texts, pp 59-61.

Rasaka (calamine) : the author of R. R. S. has evidently borrowed his description of this mineral from the present work. Cf. Vol. i, p. 87.

Extraction of zinc from calamine :

(The process agrees almost word for word with what is given in R. R. S. The essence possessing the lustre of lead runs out of the crucible.*)

Sans. texts, pp. 61-62.

Saurāśbī or tuvarī (alum-earth) almost identical with R. R. S. Cf. Vol. i, p. 91.

* * * The essence extracted from the alums (i. e. oil of vitriol) is to be used for operations with metals and not as medicine.

Sans. texts, pp. 62-65.

[Descriptions of various kinds of pits for calcining and roasting purposes are given ; as also their dimensions with the number of cowdung-cakes to be used as fuel &c. Cf. the typical roasting pit in Vol. i, p. 127.]

Here ends Chapter X of Rasaprakāśasudhākara by Yasodhara, son of Padmanābha.

* In R. R. S. we have 'the essence possessing the lustre of tin.'

Sans. texts, pp. 65-66.

Hemakriā or process for the fabrication of gold : "I shall now speak of some curiosities of metals, partly from my own experience and partly from the classics on the subject. Calamine, cinnabar, copper pyrites and realgar are to be rubbed with the milky juice of *Euphorbia nerifolia* for 7 days together and then to be digested another 3 days. Melted copper or silver or lead, being alloyed with the aforesaid mixture, acquires the power of converting 100 times its weight of base metal into gold."* Cf. *ante*, p. 2.

Chemistry in Rasachintamani Of Maḍanantadeva.

Sans. texts, p. 68.

Svetabhasma : Cf. *ante* p. 16 and also Vol. i, pp. 250-51.

Sans. texts, pp. 69-70.

Two processes for the fabrication of gold :—
much the same as already quoted from Yasodhara.

Process for the fabrication of silver :—

Take 1 part of bell-metal, 2 parts of silver, 4 parts of steel (?) * * these to be fused with

* मसवेदी and चङ्कसवेदी are technical terms ; for the meaning of मसवेदी vide Vol. i, p. 120.

tin and borax ;—by this process will be made silver which will pass current for commercial purposes.

Sans. texts, p. 71.

Extraction of zinc from calamine :—

The process is much the same as given above (p. 17), with this difference that, whereas Yaso-dhara hits off the completion of reduction when the flame issuing from the pot ceases to be blue, the present author directs that the pot is to be taken out of the furnace as soon as white fumes begin to appear. The crucible is then to be held in an inclined position so that the lead-like essence of calamine drops on the ground.

Chemistry in Rasakalpa (Rudra-yamala Tantra.)

Bowing to Siva, the lord of mercury, and also, the feet of Chavdikā, I write this Rasakalpa, the depository of mercurial lore.

CHAPTER I.

Tests for killed mercury :—

Killed mercury is that which is devoid of (metallic) lustre, not so ponderous, white,* des-

* The author previously refers to the red, black, white and even yellow ash (calx) of mercury ; it is not clear why he should

trover of metals, divested of fluidity and non-volatile when stirred over a fire. 40 Cf. tests in Rasārnava in Vol. i, p. 74; as also in Rasaratnākara, *ante*, p. 9.

Purified mercury should be preserved in the hollow of a tooth or gem or bamboo. 42

CHAPTER II.

Gold, silver, copper, tin, lead and iron—these are the 6 metals; vartaloḥa, &c., (Vol. i, p. 114) are simply alloys. 1

Honest readers! I beseech you with folded arms to favour my book with your merciful glance.

The mahārasas are 8 in number; e. g. mercury, cinnabar, sasyaka, rasaka, &c. ... the rasas are mica, green vitriol and rājāvarta, &c. ... sulphur, orpiment and realgar, &c. are the uparasas as regarded by learned teachers. Cf. Vol. i, pp. 79 and 89.

There are 4 kinds of sulphur:—white, black, yellow and red. Cf. Vol. i, p. 90.

* * * *

here restrict himself to the white variety only. Chloride or sulphide of mercury, when treated with a metal and heated, *kills* (i. e. parts with its chlorine or sulphur to) the latter and in that sense it is a destroyer of metals लोहनाशकः

The saurāśhetris (alums) are of various kinds ; the kāsīas (vitriols) are of 3 kinds,—namely, kāsīa proper, pushpa kāsīa and hīrakāsīa.* Cf. Vol. i, p. 91.

Gairika is stated to be of 2 varieties,—the one of golden hue, the other red ; Kaṅkuśtha and other rasas are also described by certain teachers ; but these, however, are not referred to here, as we are treading in the footsteps of sages of old.†

Sans. texts, pp. 75-78

For the purification of mercury this process is recommended by Svachchhandabhairava and Govinda.

Chulikalavana (Sal-ammoniac), sulphur and the ash of ginger, &c., digested one hundred times with cow's urine,.....make a vidā for killing gold. Cf. Vol. i, p. 72.

This process for killing [metals] was revealed by Siva and has been transmitted by successive schools of adepts.

* Hīrakāsa is the name by which green vitriol is known throughout India; Royle supposes that this word is derived from the Persian Azra green, and Sans. kāsīa, (Antiq. Hindu Med.) There is no necessity for looking upon hīrakāsa as a hybrid term, seeing that it occurs in the present work in which Mahomedan influence is nowhere traceable.

† Evidently Charaka and Susruta, who mention only a few commonly occurring minerals. *Vidā* Vol. i, pp. 29 and 44.

Extraction of the essence of copper pyrites. Cf. Vol. i, pp. 70 and 84.

Extraction of zinc from calamine :—

The process is practically the same as given in R. R. S. Cf. Vol. i, pp. 87-88.

I have performed the [aforesaid] experiments with my own hands and have seen them with my own eyes. They are not recorded from mere hearsay or from the dictation of a teacher. These are being promulgated for the benefit of mankind.

Chemistry in Rasarajalakshmi of Vishnudeva.

Sans. texts, pp. 79-82.

Give an account of the common rasas and uparasas. Cf. Vol. i, p. 79.

Chemistry in Rasanakshatramalika of Mathanasimha, physician to the King of Malwa.

There are several prescriptions given in which mineral preparations play a conspicuous part. We have quoted only two ; in the first, among other ingredients opium occurs ; in the second, the

Svachchbandabbairavarasa, probably named after the celebrated alchemist, we have the *calces* of tin, iron and mercury along with other drugs.

Chemistry in Rasaratnakara of Nityanatha.

Sans. texts, pp. 84-86.

Test for killed mercury :—

When the substance, being heated over a fire of paddy husks, does not further decrease in weight, it should be considered as reduced to a calx.

Purified mercury should be stored in the hollow of a tooth or horn or bamboo.

Directions for making factitious cinnabar (Makaradhvaṛa). Cf. Vol. i, p. 132 (footnote).

Chemistry in Dhaturatnamala.

In the beginning the author after salutation says : "I shall speak of silver, gold, copper, lead, tin and iron as also of calamine, mica, pearls, coral, orpiment, realgar, the pyrites, mercury and diamond,—in fact, the properties of all the metals and minerals and the mode of their incineration."

Killing of silver. Cf. Vol. i, p. 107.

Chemistry in Rasapradīpa.

Description for preparing mineral acids by distillation :—"Saṅkha-drāvaraṣa or liquid for dissolving conchshells,—practically the same as given under "mineral acids" in Vol. i, p. 186. The last line says : "Cowrie-shells and metals dropped into the liquid are at once dissolved."

Preparation of calomel and treatment of "phiraṅ-garoga" (syphilis) with its application. Cf. Vol. i, p. 252.

Chemistry in Dhātukriyā or Dhātumanjari (Rudrayamala tantra.)

Sans. texts, pp. 98 et seq.

Tin, iron and copper are to be classed among the superior metals.

In general a metal being alloyed with silver is improved in quality. Sattvaja metal (*i.e.* an alloy of tin and copper, *vide* below couplet 15) is of middle quality. 12.14

Synonyms of the different metals. 39-49

Synonyms of zinc : Jāsatva, Yasadāyaka,* rūpyabhṛātā (lit. brother to silver), charṇaka, kharpara, rasaka, &c. 50-51

* Yasada is the name commonly given to the metal extracted from calamine. *Vide* Vol. i, p. 156

Pittala is an alloy of copper and zinc. 63

Kāmsayaka is an alloy of tin and copper. 65

Zinc being amalgamated with mercury gives rise to rasaka. 68

[*N.B.*—Rasaka and kharpara are the names generally applied to the mineral calamine (*vide* Vol. i, p. 158), but here they stand for the metal (zinc) or its amalgam.]

Lead being killed with the aid of gentle heat gives rise to minium (red lead). 69

Copper in combination with the "burning water" gives rise to tuttha (green vitriol).—Thus manifold operations are performed with the aid of *mantras* and apparatus: all these belong to the province of Chemistry. 70-71

Synonyms of haritāla (orpiment): Orpiment is a compound of mercury and also a clipper of its wings.* 79

Synonyms of realgar, cinnabar, mica, &c. 81-89

Synonyms of pearls, coral, tortoise-shell, conch-

* The sulphide of arsenic on being rubbed with mercury and gently heated converts the latter itself into the sulphide. The mercury is thereby *killed* and *fixed* i.e. deprived of its volatility (clipped of its wings—the Hindu alchemist's favourite figure).

shell, tusk of elephants, the tail of the peacock.

90-108

Localities for different metals. 113-121

[The information is very commonplace.]

Localities for copper specified : Nepāl, Kāmārūpa (the eastern portion of Assam), Bangala, † the country of the Mlechchhas, Rūma and the country of the Phirangas, &c. 143-145

Localities for zinc : Kāmboja, Rūma, Balkh, &c. 146

Metals in combination with mercury and sulphur become fit for administration as medicine. 153

* * *

Process of roasting a substance in a stout glass-vessel using goat-and-cow-dung-cakes and husks of paddy grains as fuel. 9 10

One part of gold and four parts of zinc are to be melted together and the alloy roasted in a closed crucible . . . the process repeated with the addition of alkalies . . . gold of a reddish yellow colour will thus be generated. 11-17

* All these have been placed under the category of (दुर्लभ) inferior dhātu. Though the term dhātu generally means a metal, it is often applied to a mineral ; here, however, it covers a much wider field.

† This is the name given to Bengal in many Tantras.

A process for making factitious cinnabar by pouring mercury into its own weight of molten sulphur and then adding three-fourths its weight of orpiment The mass to be rubbed in a mortar and subjected to sublimation, 23-30

By using the *augmented** gold as a means of exchange one can amass wealth. 52

Tin is to be melted and one-hundredth part its weight of mercury to be amalgamated with it. This [fraudulent substitute for] silver can be used for purposes of exchange, and one can thus amass wealth. 85-86

Pure gold is to be alloyed with one hundred times its weight of copper and this [imitation] gold will resemble native gold, 88

Lead and copper being alloyed together will give rise to gold. 97-98

Colophon : Here ends the Chapter on the extolling of gold in Rudra-yāmala.

* Cf. footnote, p. 2.

Chemistry in Savarnatantra or Svarnatantra.

The origin of the tantra is explained in the opening lines. Parasurāma having given away his worldly possessions to Kāyapa is rendered destitute, and thus has to invoke the aid of the God *Siva* for his very maintenance.

Siva said : Listen ! I shall now reveal to you the most wonderful mysteries of *Svarnatantra*, 1-10

A kind of oil is exuded from the bulbous root of a plant ; all around it within a radius of ten cubits oily water is exuded and a venomous snake lives under it. If you want to test the properties of the bulb, you should thrust a needle into it, and the needle at once dissolves. Having procured this bulb, rub it with mercury in a mortar and add the oil and subject the mixture to heat in a crucible. The mercury is at once *killed* and acquires the property of converting one hundred thousand times its own weight of the base metal into gold.* I4-18

Pure orpiment is to be robbed with this oil for 20 days, and the former is killed thereby and loses its volatility. The 8 metals in the molten state being treated with this prepared orpiment acquire

* लघुविधौ महेत्.

the power of transmutation. When the above oil is thrown into molten copper, it is turned into gold of beautiful lustre. Tin and bell-metal similarly treated are turned into silver, and copper, iron, brass and silver into gold. 19-24.

Saukhabadrāvaka (*aqua regia*, see *ante* p. 24) is spoken of as an universal solvent This solvent with mercury is to be placed in a glazed crucible and subjected to heat; the mercury, thus *killed*, can convert the 8 metals into gold. By partaking of this mercury one becomes immortal; even his urine and faeces can convert copper into gold.* 1-10

* This sort of belief was prevalent also at the time of the composition of Rasārnava.

Knowledge of Gems.

A few words on gems may not be considered beyond the scope of the present work especially as the subject has already drawn the attention of some European scholars.* We shall, however, limit ourselves, as far as possible, purely to the physical and chemical properties of the precious stones.

It has already been seen that among the 64 branches of arts and sciences recognised in the ancient 'Kāmasūtra' of Vātsyāyana occur the following :—(a) the testing [of the genuineness or otherwise] of gold and the gems ; (b) knowledge of the colouring of gems, as also of mines and quarries,† Varāhamihira (d. 587 A. D.) in his "Vr̥hat Samhitā" also conveys much useful information on this subject, but as he in his turn refers

* Garbe in his "Indischen Mineralien" (Leipzig, 1882) gives the text and the translation of Ch. xiii of Narahari's "Rājani-ghaṇṭa"; this work, however, is comparatively modern. Much useful information on the subject with bibliographical references will be found in Professor Yogann Chandra Rty's treatise in Bengali entitled "Ratnaparikshā."

† Vide Vol. i, p. 191.

to experts who preceded him,* it may safely be concluded that long before this time it received adequate attention.

The Garuḍapurāṇa under the heading of Ratnaparīkṣā (examination of the gems) devotes several chapters to a detailed and fairly exhaustive description of the gems. This Purāṇa like so many of its class discusses on a variety of topics, mundane and spiritual ; in short, it may be looked upon as a sort of *multum in parvo*.

From time immemorial the gems have been valued in India not only for purely decorative and ornamental purposes, but also as agents for warding off perils and the malignant influences of the planets and for securing luck and longevity. Hence it is that particular attention is paid to the testing of gems, as their virtue increases in proportion as they are faultless and flawless.

The typical characters which were most relied upon for differentiating one species of a gem from another were (1) the relative weight, (2) hardness, (3) lustre, transparency and colour, (4) fusibility, especially when heated in combination with the alkalis. It will be noticed that even the lapidaries

* द्रुमाचार्यः समुद्दिष्ट

and the mineralogists of the present day have to depend largely upon these properties in the classification of the *stones*. We shall now proceed to say a few words under each of the above characters following in the main the authority of Garudapurāṇa.

1. RELATIVE WEIGHT. We have purposely used these terms as contradistinguished from "specific gravity": as the latter connotes peculiar associations. The principle of Archimedes being evidently unknown among the Hindus, the measurement of volume could only be roughly approximate. To cite some illustrations. A stone may be of the same species as, and equal in volume to, a padmarāga (oriental ruby), but will differ in weight from the latter.*

Empirical and arbitrary scales of weight were adopted as standards. A ruby occupying the volume of a guṇja (*abrus precatorius*) may be equal in weight to 10.7 and 3 guṇjas respectively. A ruby of the volume of a *śṛigāṭakola* (a kind of jujube) should weigh 12, 8 and 7 guṇjas respectively. Again, a ruby of the volume of an āmalakī (*phyllanthus emblica*) should weigh 30, 20

* गुण्यमनापञ्च च गुण्यजातेष्वी वा गुह्येन भवेत्त गुणः ।

and 16 māśhās respectively.* In each case the gem which is of greater weight is superior in quality and the value thereof is enhanced in proportion.†

In the case of precious metals, however, adulteration was detected by an ingenious device, which may be regarded as a near approach to the principle of Archimedes. Suppose it is intended to test the purity of a specimen of gold. All that one has to do is to draw a wire of this gold and another of the standard gold through the self-same orifice [of corundum]. As these wires are of equal

* We give below the standard weights as current at the time of Varghaṃbīra.

8	White mustards	...	=	1 tanaḍala (a grain of paddy)
4	Tanaḍalas	...	=	1 gunja (<i>abrus precatorius</i>)
5	Gunjas	...	=	1 Māśhā
16	Māśhās	...	=	1 Karsha or surarna or tolaka
4	Karshas	...	=	1 pala

The standard of weight has always varied in different times in different parts of India. 10 gunjas weigh about 18 grains. The seeds often vary in size.

† Garuḍa lays special stress on the high specific gravity (=4.0) of a genuine ruby. लघुत्वं विनाशिलिङ्गं. अथवा सुदृढं मन्वीर्णं सुधसंयुतः। While high specific gravity is indicative of the excellence of the gems in general, in the case of diamond it is just the reverse. इदमा सर्वैरद्यानां शौर्यवाचककारणम् । अङ्गी तत् वैपरीत्येन सुख्यः परिचयते ॥ It is not easy to account for this qualifying clause, seeing that diamond has a sp. gr. of 3.5.

diameters, equal lengths will have equal weights, provided the sample is pure.*

2. **HARDNESS.** There are many stones which in external appearance resemble a ruby, the spurious substitute may easily be detected by its difference in softness (low degree of hardness), and low specific gravity: again in case of suspicion the gem is to be rubbed on a whetstone; if it simply gains in lustre but does not lose in weight (by abrasion), the specimen is to be regarded as genuine (test of a ruby).† Diamond and corundum alone will scratch ruby and sapphire. Skilful lapidaries often make imitation diamonds of zircon, ruby, cat's-eye, rock-crystal and glass; hence they are to be tested by calling in the aid of learned experts. All the gems occurring in this world as also the metals will be scratched by a diamond, but the latter will not be similarly affected by the former.A diamond alone will scratch a diamond.‡

* एकच्छिद्रे समानाकारे समस्तवर्त्ये द्रव्योऽर्था ।

शाली: सूत्रं मानसम् निर्दुष्टं अभिज्ञतः ‡ Sukranditi.

† This is true in a qualified sense only. After the diamond corundum is the hardest of all known minerals.

‡ The ruby and the sapphire are only varieties of corundum. Varāha classes corundum as a species of ruby, the former being dotted over with black and white patches and feeble in lustre (i.e. the non-transparent or coarse kind). It is scarcely necessary to

To the above tests Rājānighānta adds another, namely, when a diamond is struck with an iron hammer, it is not broken to pieces*.

point out that the very word "corundum" is derived from the Hindi *berand*, a corrupt form of the Sanskrit *śaravinda*. The statement "corundum will scratch ruby and sapphire" is not strictly accurate. There are degrees of hardness among the different varieties of corundum, the blue sapphire standing first in this respect.

We give here the original texts of which we have given above almost a literal translation.

"सोढुममेदी सदुता लघुस्व विजातिविह्वं कम् नान्ननम् ।"

"नमश्चयति सन्देहं शिलया परिघटयेत् ।

इहा सोढुममयोभावात् परिभाष न सुखणि ।

स श्रेयः सुहृन्नातिशु ज्ञेयाशान्ते विजातयः ॥"

"नक्तं वा कुचविन्दं वा विमुच्यान्तेन केनचित् ।

न यत्वं लेखनं कर्तुं पद्मसिन्दूरीशयोः ॥"

* The reading of the text is very corrupt. Garbe gives as many as 12 variants; that adopted by him seems to be on the whole reliable as also his rendering: "Wenn er mit anderen steinen oder eisernen Hammern geschlagen nicht zerpringt." On account of its brittleness a diamond will readily be shivered into splinters under the blow of a hammer. The following extract from Bauer and Spencer's "Precious stones" (pp. 129-130) may prove of interest.—

"The hardness of diamond has often been confused with its fragility or brittleness. It has been supposed, especially in ancient and mediæval times that hammer and anvil may be shattered but not the diamond which lies between.

3. **LUSTRE, TRANSPARENCY, COLOUR** and other optical properties. Difference in lustre (बेजगिरी) is often regarded as a diagnostic feature of the gems. According to Varāha gems of superior qualities should possess cool (lit. waxy) lustre, be limpid and emit rich rays. Classification according to colour is often enjoined. For instance, a diamond may be perfectly colourless, or it may be yellow,

This statement was made by Pliny, the great naturalist of ancient days, who was killed in 79 A.D. at the first historic eruption of Vesuvius. He proceeded to say further that the fragmentation of a diamond may be effected by subjecting it to a preliminary immersion in the warm blood of a goat, but that even under these circumstances the hammer and anvil will also be broken ! According to Albertus Magnus (1205-1280) the blood is more efficacious if the goat has previously drunk wine or eaten parsley.

"Such being the views then held respecting the unbreakable and indestructible character of the diamond, it is easy to understand why the Greek word *adamas*, signifying unconquerable, should have been applied to this stone, although its application to the diamond is singularly inappropriate and inaccurate when its extreme fragility is considered. Many a doubtful stone has been submitted to the test of the hammer, with the belief that the blow would be resisted only if the stone were a genuine diamond. Probably many beautiful stones have been sacrificed to this old belief. As a matter of fact, diamond is easily fractured, a very moderate blow from a hammer sufficing for the purpose ; its perfect cleavage places it among the most brittle of minerals."

black, red or copper-tinted.* Stones which are translucent, opaque and of dull colour are inferior in quality. In the case of diamond special stress is laid on its displaying the colours of the rainbow [due to its high dispersive power]. Some gems have only one shade of colour (एकवर्ण) others again two (दिव्य)†

The changes in colour which the ruby and the sapphire undergo under the influence of heat had evidently been carefully observed. This test is to be applied with extreme caution as in case the pro-

रक्त पीतं सिद्धं वैदिक (Varāha)चामरम् (Garuda).

Yellow diamonds are unknown in India at the present day at any rate. "India can claim for its own all the finely coloured stones of blue, green and red, not however, yellow diamonds, which come mainly from South Africa," (Bauer and Spencer). Crystals of black diamond should not be confounded with the black carbonado.

† Probably refers to dichroism. As has already been pointed out the red ruby and the blue sapphire are only varieties of corundum, which often occur in well-developed crystals belonging to the rhombohedral division of the hexagonal system. "The dichroism of the ruby affords a means whereby it may be distinguished with certainty from other red stones, such as spinel and the different varieties of garnet, which crystallise in the cubic system, and thus being singly refracting can show no dichroism," (Bauer and Spencer). "The dichroism of the sapphires of Siam is specially well marked."—*Ibid*.

per degree of temperature *अपिमाना* is exceeded, the stone may be materially injured.*

4. FUSIBILITY (LIQUEFACTION). It was well-known that all the gems with the exception of diamond would undergo liquefaction when strongly heated with a mixture of the two alkaline carbonates [now familiar in the Laboratory as the "fusion mixture"]. The liquid principle of gems *रत्नस्य द्रुति* was a favourite remedy with the Hindu Iatro-Chemists (Cf. Vol. i, p. 103). As most of the precious stones belong to the corundum and the spinel group, they easily yield to treatment with sodium and potassium carbonates. In the case of the pearls it is recommended that they should be enclosed inside lemons and placed in a mass of paddy grains [for the sake of the warmth].

* यावन् चतस्रिदशं पञ्चराशौपधीयतः (१) ।

इन्द्रनीलमणिमय्यात् क्रमेण सुसङ्गतम् ।

तदापि न परोक्षार्थं गुणानामभिज्ञये ।

मन्दिरघ्नौ सुभाषेयः कथञ्चिदपि कथनः ।

अपिमानाऽपरिग्रहे दाहदोषेय दूषितः ।

सौडमर्षाय भवेद्भर्तुः कर्तुः कारयितुमशकः ॥ *Garuda*.

Cf. "The red ruby, at a high temperature, is colourless; on cooling it first becomes green, after which it gradually assumes its original fine red colour." (Bauer and Spencer). "The blue colour of the sapphire disappears on heating."—*ibid*.

GENERAL AND CONCLUDING REMARKS.

The crystalline character of the minerals is referred to in one or two places. All the old writers agree in describing the diamond as having 6 angles, 8 faces and 12 edges.* The octahedral form of the crystal is common in the diamond occurring in the neighbourhood of Panna in Bundel Khand. Rājanighanta further adds that the stone is often endowed with numerous faces and edges.† According to Rasaratnasamuchchaya the female diamond is flattened and rounded whilst the neuter is rounded and obtuse-angled‡ Vaikrānta is also

* कीलाः षडङ्गानि अष्टादश वङ्गानि द्वादशैति । *Gāruda*.

† "In most cubes of diamond, however, each edge is replaced by two faces,.....the twenty-four faces thus derived would, if produced or enlarged" sufficiently, give rise to the form known as the four-faced cube, or tetrakis-hexahedron. (Bauer and Spencer).

‡ The rendering of the description of diamond in R.R.S. (*vide* Vol. i, p. 100) is based upon a misreading. The correct reading is that adopted by the Poona edition, namely, अष्टासं षडङ्गलकं षट्कार्णं "a diamond has 8 faces and 6 angles." The author evidently uses वङ्ग and ङ्गलक in the same sense; there cannot be any confusion here, as distinct mention is made of the 6 angles. As a rule वङ्ग and कील are used synonymously. Thus in Vardha वङ्ग is described as दृढवङ्ग; the commentator Bhaṭṭotpala explains it वङ्गं निरन्तरिभिर्दृढं षट्कोणमिहलङ्कः । "Rounded" (वर्तुल); Cf. Bauer and Spencer. "The faces of diamond crystals differ from those of most other crystallised minerals, in that they are as a

(probably a mineral of the spinel group. *vide* Vol. i, p. 83) described as having 8 faces and 6 angles.

It is sometimes asserted that the phosphorescence of diamond was first observed in 1663 A. D. by the celebrated Robert Boyle. Bhoja (11th century A.D.), however, mentions this property.* Faults in precious stones due to isolated grains of minute gravels etc., embedded in the mass [now technically called "enclosures"], are also referred to.†

It may be noted here that what is generally known as the Indian or Tavernier's rule for determining the value of diamond can be traced back to a remote date. *Sukranīti* speaks of it as the "rule of squares,"‡ while *Varāha*, himself a great rule, much curved and rounded instead of being perfectly plane as is usually the case." p. 119. "Obtuse-angled" (कुक्षकोणाद) in the crystallographic terminology should be rendered as "with corners truncated off."

* अन्धकारे च दीप्यते (phosphoresces in the dark).

† कलुषा मन्दसुखी लेखाकोषीः सधातवः खण्डाः ।

दुर्लभा न मनोज्ञाः समकौशलेति मणिविदोवाः ॥ *Varāha*.

Here *सधातवः* and *समकौशरः*; no doubt refer of the minute pebbles (gravels) enclosed in the body of the stones.

‡ यथा सुखतरं वज्रं तन्मूल्यं रत्नवर्गमतः; i. e. if a diamond weighing 1 *ratī* be worth *x*, one of the weight of 4 *ratīs* will be worth $2 \times x$.

mathematician, gives practically the same rule, though somewhat on an elaborate scale.*

It would be unfair to compare the progress made by the Hindus in this branch of knowledge in the 6th century A.D. and perhaps earlier with that of the present day. Reference to the crystalline forms of diamond can be found in the writings of Keppler, Steno and Robert Boyle in the seventeenth century. Scientific crystallography originated with Romé de l'Isle and the abbé Haüy at the end of the eighteenth century. The various physical and chemical properties of the minerals culled here bespeak considerable powers of keen observation.†

i. e. if a diamond weighing 20 *tanakulas* (p. 33 *note*) be worth 2 lacs (2,00,000), one weighing 5 *tanakulas* will be worth only $(5^2 \times 4 = 100)$ th part of 2 lacs or 2,000.

† Concerning Ratnaparikshā cf. also "Les Lapidaires Indiens" by M. Finot in the "Bibliothèque de l'École des Hautes Études."

NOTE ON THE METHOD OF PREPARING CAUSTIC ALKALI.

In the first Volume of our History the detailed description of preparing caustic alkali from the ashes of plants has been quoted at length from the Susruta and we referred to it "as a proof of the high degree of perfection in scientific pharmacy achieved by the Hindus at an early age."* M. Berthelot has no less been struck with the originality of this process; indeed, he goes so far as to suggest that this portion in the Susruta is evidently modern and in fact a later addition derived from contact with the European chemists.†

The process of rendering mild alkali caustic by the addition of lime is to be found also in Chakrapāni (c. 1050 A. D.) and Vagbhata, who must have preceded the former by several centuries, and it is well known that both these authors are deeply indebted to the Susruta. There is not thus the remotest chance of inspiration from the European chemists.

* Vide Vol. i, Intro. c.

† Journal des Savants, Jan. 1903, p. 42.

We have evidence from quite an unexpected and independent source that the cauterization of bad wounds by means of caustic alkali was an established custom in ancient India. Thus we read in "The Questions of king Milinda" :—

"And when the inflammation had gone down, and the wound had become sweet, suppose he were then to cut into it with a lancet, and burn it with caustic. And when he had cauterized it, suppose he were to prescribe an alkaline wash Now tell me, O king ! would it be out of cruelty that the surgeon thus cut with the lancet and cauterized with the stick of caustic,"*

* "Sacred Books of the East," Vol. XXXV, p. 168.

Although Milinda has been identified with the Bactrian Greek king Menander (c. 140—110 B. C.), it is not to be supposed that any Greek influence can be traced in it. In this ethical romance, king Milinda and the Buddhist Bhikshu Nāgaseṇa have been put forward simply "as men of straw" to quote Rhys Davids. The work in reality conveys the teachings of the older Buddhists (Hinayanists) with the background of Śāṅkhya and Vedānta metaphysics.

The Tantrists, the Rosicrucians and the seekers after truth.

The East has not been always East and the West, West. Modern Europe is materialistic, but she has not disclaimed in the past to "plunge in thought." This reminds us of the truth of the poet's words: "one touch of nature makes the whole world kin." Ancient Greece had her orphic mysteries. They were developed into a religious and ethical system by Pythagoras. In the schools of Alexandria the neo-Pythagoreans and the neo-Platonists further added to it the Vedantic doctrine of a world-soul.

"With the dissolution of the neo-Platonic school in the sixth century, Greek philosophy disappears, it is true, as distinct phenomenon from the theatre of history, but it continues to exist in combination with foreign elements in the service of a new form of culture in the Science of the Middle Ages and of modern times." (Zeller).

Says Waite :—

"The traditions of the new-Platonic philosophy, with its elaborate theurgical system, were to some extent perpetuated through the whole period of the Middle Ages, for besides the orthodox theology of the great Latin Church and amidst the clamour of scholastic philosophy, we find the secret theosophy of the magician, the Kabbalist, and the alchemical adept borrowing, directly or indirectly, from this prolific

fountain of exalted mysticism. The traces of its influence are discoverable in Augustine, in Albertus Magnus, in St. Thomas, the angel of the schools, and in other shining lights of western Christendom, while the metaphysical principles of Johannes Scotus Erigena, even so early as the close of the ninth century, were an actual revival of this philosophy.*

History repeats itself. In India the Yoga doctrines of Patañjali paved the way for the origin of Tantric mysticism and it associated itself with magic and alchemy. Some twelve centuries later, this phase in the stage of human progress found exponents in the soil of Europe. As Waite says :—

"In an age of progress, of doubt, and of great intellectual activity, it is singular to remark the almost invariable prevalence of mysticism in one or other of its manifold phases, and the close of the sixteenth century beheld spreading over the whole of Germany and passing thence into Denmark, France, England and Italy, a mighty school of mysticism in the great multitude of magicians, alchemists, &c., who directly or indirectly were followers of the renowned Paracelsus."†

*"History of the Rosicrucians," p. 27. Regarding the sect of the Cabalists see also Lecky's "Rationalism in Europe."

Vol. i, p. 42, ed., 1900.

† See also Kopp's "Die Alchemie in Alt. u. neu. Zeit," ii, pp. 1—146, on the "Bekantschaft mit Geheimnissen der Magie, Theosophie, Alchemie u. A."

Even the lower strata of society in England did not escape the contagion. Sir William Temple observes: "I have had several servants far gone in divinity, others in poetry, have known in the families of some friends, a keeper deep in the Rosicrucian mysteries."

There are those who sneer at the attempts of the alchemists to convert the baser metals into gold and are at the pains to insinuate that the motives of the adepts were sordid. It may be that there have been here and there men—vulgar charlatans—who have pursued the art merely from worldly considerations. The high priests of alchemy, however have in every age and clime been honest seekers after truth. Had there been no desire implanted in the human breast to pry into the hidden and occult mysteries of nature there would have been no science. Whence come we and whither are we destined to go? What is this substance made up of, and what are its ultimate constituents, and what will its combination with this or that lead to? These are queries, the solution of which or rather the very attempts to solve which mark the birth of philosophy. Patañjali and Nāgārjuna in India and Paracelsus in Europe stand forth as the prominent representatives of

this spirit of inquiry. They have been dreamers, mystics and naturalists all combined in one. Such geniuses have always chafed at the restraints and limitations imposed on frail man and hence their fervid yearnings to peep into regions beyond the ken of our gross senses. As Emerson puts it :—

"The privilege of this class is an access to the secrets and structure of nature, by some higher method than by experience. In common parlance, what one man is said to learn by experience, a man of extraordinary sagacity is said, without experience, to divine."^{*}

Plotinus heaved a sigh at the soul with its infinite possibilities being caged in a frail and corruptible body. The pursuit of alchemy by the *esoteric Tānist* is easily explained. To him it was only a means to an end. "It (mercury) is alone that can make the body undecaying and immortal."[†] We find echoes of the same sentiment in the authoritative literature of the Rosicrucians,

Says Waite :—

"Among the concourse of inquirers, and the clamour of supposed and pretended discoverers, there rose gradually into deserved prominence an advanced school of illuminati,

^{*}"Swedenborg ; or, the mystic."

[†] Vide "History of Hindu Chemistry," Vol. i. Intro. lxxvii and xcv—xcvi.

who, employing the terminology of the *libra philosophorum*, under the pretence of alchemical pursuits appear to have concealed a more exalted aim. . . . The student is directed by these writers from the pursuit of material gold to the discovery of incorruptible and purely spiritual treasures. . . . Physical transmutation, the one and supreme end of the practical alchemist, sinks into complete insignificance ; nevertheless, it is performed by the adept and is a landmark in his sublime progress." L. c. p. 32.

The sage and seer of Hohenheim had his wrestlings. Should he pursue knowledge for its own sake or for what it bringeth ? His evil genius holds out the bait thus :—

"Know not for knowing's sake
But to become a star to men for ever ;
Know for the gain it gets, the praise it brings,
The wonder it inspires, the love it breeds."*

The spiritual at last triumphs over the base in man. Paracelsus has his revelation, and he bursts forth :—

"Truth is within ourselves : it takes no rise
From outward things, whate'er you may believe,
There is an inmost centre in us all
Where truth abides in fullness : and around
Wall upon wall, the gross flesh hems it in,
The perfect clear perception—which is truth."*

* Browning's "Paracelsus."

In the above delineation the poet has done no more than bare justice to the inward longings of an ideal alchemist, who is only an honest seeker after truth. The spiritual and thought-world has always transgressed all barriers of time and space. Kanāda, Patañjali and Nāgārjuna of India and Heraclitus, Empedocles and Plato and the rest—they all form a holy fraternity; aye, these prophets and oracles of the intellect belong to a "lofty and sequestered class," "the high-priesthood of the principles of thought from age to age. When at long intervals we turn over their abstruse pages, wonderful seems, the calm and grand air of these few, these great spiritual lords, who have walked in the world,—these of the old religion,—dwelling in a worship which makes the sanctities of Christianity look *puerilities* and popular; for 'persuasion is in soul, but necessity is in intellect.' "

• Emerson : on "Intellect."





The metals and their loss in weight after calcination.

Very vague ideas prevailed among the Hindu philosophers on the constitutions of a metal and its fate after calcination. We are reminded of the diversity of opinion in Europe before the time of Lavoisier. A metal like every material substance was supposed to be formed of one or more of the five, *bhūtas*; in fact the earthy or saline element was taken to be predominant in it,* and hence it lent itself so readily to calcination; † It should be noted here that by "*bhūta*" was understood not so much an element in the modern connotation of the term as certain qualities of individual substances. Even mercury was regarded as composed of the five *bhūtas*. ‡ When a metal was submitted to calcination some of its component *bhūtas* escaped, leaving the earthy or saline portion behind; hence the ash (*calx*) must weigh less than the original metal itself

* पार्थिवः सुवर्णरजतमणिमुक्तामयः शिलासततपाशादयः। Ch. I., 4. 2
Again in Ch. XLVI (Śāstra) 345 et seq. the metals are included among the saline ingredients.

† Cf. "For some maintain that gold is solid light, or, at least that the chief ingredient is light, which is rendered solid by mixture with some particles of earth. *Were it more earth it might be calcined by fire strongly urged.*—Vol. 1. P. 9.

‡ पञ्चभूतानाम् न. ध्वनिप्रत्ययेन सदाशिवः। रवि रक्षार्थम्।

There is, however, no direct reference to be met with anywhere as regards the quantitative aspect of the question so clearly established by Lavoisier.

The proportion of loss which a metal undergoes on ignition was made the basis for determining its purity and we find in the law-books an arbitrary scale fixed. Thus according to Yājñavalkya, "gold is unaffected by fire, while one hundred parts by weight of silver, tin and copper lose (lit. undergo decay to the extent of) two, eight and fifteen parts respectively.* This is to be taken as referring not to the roasting (killing) of a metal but simply as allowance made to goldsmiths and other artisans for loss incurred in the shape of dross &c. when it is melted in a crucible.

That copper, lead, tin and other base metals (दीनधातवः) when repeatedly calcined are completely reduced to their calces was well known as will be seen throughout the body of the texts. The passage from Rasesndra-chūdāmaṇi (p. 14) deserves some notice. Lead of the weight of 30 *palas* is to be calcined till its weight is reduced to a *karsha* ($=\frac{1}{4}$ *pala*). Even if it be calcined now one thousand times, it will not undergo further reduction in weight. Our author evidently had his experience of lead derived from argentiferous galena, which would leave

* अग्नौ सुवर्णमदीक्षं त्रिपलं दहति गते ।

a residue in the shape of a "button" of silver after the lead had been cupelled off. •

• Similar confusion prevailed in Europe up till the end of the 17th century. The following extract from Robert Boyle's "Concerning the Unsuccessfulness of Experiments" will make the point clear.

"Having, upon occasion, had the curiosity not long since to visit some mines of lead and other metals, I find that there is a great difference, and discernible even to the eye, betwixt the several ores; for instance, of lead, some of which I can show you so like steel, and so unlike common lead-ore, that the workmen upon that account are pleased to call it steel-ore, which being of more difficult fusion than ordinary, they are wont to mix it with other ore, which they call firm-ore, to facilitate the melting of it. And I likewise took notice of an ore, which for its aptness to vitrify, and serve the potters to glaze their earthen vessels, the miners call potters-ore, and sell it (at least where I saw it digged up) dearer than other ore, from which it differs both visibly enough, and as the workmen affirm in divers other (and those less obvious) qualities; and yet all these ores, after fusion, do pass indiscriminately under the name and notion of lead. In which therefore it is no wonder, that severer inquiries find a great deal of disparity. I remember I did not long since cause some lead-ore to be tried, which being the most promising that ever I saw, made me suppose it might contain some considerable quantity of silver; but though it proved so rich in lead, as to yield after the rate of seventy pound to the hundred, yet one of the most expert artists in Europe could not extract one grain of silver out of it; whereas the lead of very many mines, being skilfully examined, will leave behind it, upon the test, a proportion of pure silver. And though this quantity of silver be not considerable enough to make such mines as yield it pass for silver mines.

Antimony.

Although there is no direct recognition of antimony as a distinct metal, some sort of allusion to it as a variety of lead is not wanting. The reason why antimony was often confounded with lead is that at first sight stibnite may be mistaken for galena. The mineral *sanyirāñjana* or *nikāñjana* was thus indiscriminately applied both to the sulphides of antimony and of lead (cf. vol. I., pp. 93-95). That *nikāñjana* contained a new metal was often suspected though its nature was not properly understood. Thus in *Rasendra-chūdamamā* we have "*nikāñjana*, mined with *tiksha* (cast iron), and heated several times yields a superior kind of lead which is readily fusible and is of mild black colour. *

(or, as we are wont to call them mines-royal) because the silver will not quit the cost of extracting it; yet such mines though they pass but for lead mines with the metalist, may appear to be mixt mines to the naturalist, who may meet with divers experiments, wherein the little silver that is in them, may make their lead operate differently from that of those ores, which are wholly destitute of silver."—Edition of 1772, p. 323.

* *Vide Sans. texts*, p. 52. The identical distich occurs also in R. R. S. Cf. vol. I p. 119. Cf. also "But to detain you no longer on the subject, give me only leave to strengthen the paradox I have proposed, by the authority of that great and candid chymist *Basilins Valentinus*, who speaking of antimony, after he hath told us, that there are several kinds of it, and especially two; the one more mercurial and of a golden property, witnessed by the shining streaks &c becoms it abounds with; the

**The preparation known as
Svarnasindura or makaradhvaja.**

As the "law of definite proportion" was unknown to the ancients, tedious processes were resorted to for the complete conversion of mercury into its sulphide. "Makaradhvaja" even at the present day is a favourite remedy with the Hindu physicians of the A'yurvedic school.* Let us follow the recipe as given in Rasendra-chintāmani: "when quicksilver is killed with an equal weight of purified sulphur, it becomes hundred times more efficacious; when it is killed with twice its weight of sulphur it cures leprosy; when it is killed with thrice its weight of sulphur it cures mental languor; when it is killed with four times its weight of sulphur it removes gray hair and

other more full of sulphur, but destitute of the golden nature that enriches the former; adds, that there is such a different goodness betwixt the several sorts of antimony, as there is betwixt the several sorts of flesh or fish, which, though agreeing in name and, if you please, in nature, do exceedingly differ in point of goodness, which brings into my mind the great difference which I have found, even visible to the eye, betwixt the several sorts of Antimony."—Boyle's work—*l.c.* p. 324.

* If we take the historical meaning of the term "A'yurvedic," the above preparation cannot lay claim to this distinction, for it was unknown at the time of the Charaka and the Susruta and was introduced into the *Materia Medica* during the

wrinkles; when it is killed with five times its weight of sulphur it cures consumption; and when it is killed with six times its weight of sulphur it is a panacea for all the ills that flesh is heir to.* Now 25 parts by weight of mercury can only take up (i. e. combine with) 4 parts by weight of sulphur; the excess of sulphur simply sublimes off unchanged. In the actual preparation of *avarasindūra* (Lit. vermilion with gold) the mercury is first made into an amalgam with thin gold leaves and then repeatedly rubbed in a mortar with sulphur. During the process of sublimation (चूर्णपातन) the excess of sulphur volatilises off as we have already explained and the gold in fine particles remains behind as a residue. The lustrous, crystalline, reddish brown sublimate, which collects nearest the source of heat,† has the formula HgS . As there is an erroneous impression about

- * गुल्मे तु नन्दके जीर्णे सुहास्यतृणयो रसः ।
 त्रिगुणे नन्दके जीर्णे सत्वेकुरङ्गरः परः ॥
 त्रिगुणे नन्दके जीर्णे सत्वेकुरङ्गविनाशनः ।
 चतुर्गुणे तस जीर्णे सत्वेकुरङ्गविनाशनः ॥
 नन्दे पञ्चगुणे जीर्णे चदे अचङ्करी द्रवः ।
 पञ्चगुणे नन्दके जीर्णे सत्वेकुरङ्गरी रसः ३ ५ ७ ।

† Gopālakrishna very properly lays particular stress upon this point.

स्त्रीटक्षिता तु मुक्तामसृङ्गप्रं वलिं सजेत् ।
 अथः स रसचिन्दुरं सत्वेरीनेऽ योजयेत् ॥ इति रसेन्दुसारसंक्षेपः ।

the composition of this drug even among educated people in this country we give below the results of analysis of a sample of "mercury killed with six times its weight of sulphur along with gold."*

Identification of metals by their colouration of flames.

Prominent attention should be drawn to the following extract from *Rasārnava* (Vol. I., p. 68.)

"Copper yields a blue flame * * * * *
that of the Tin is pigeon-coloured ; that of the Lead is pale-tinted"

We are not aware of similar tests being applied anywhere at such an early period as a qualitative test for metals.

The age of Bhikshu Govinda the author of *Rasahrdaya*.

There is a belief current in some parts of the Deccan that our Govinda is no other than the celebrated teacher of Śaṅkarāchārya. † If there be any historical foundation for the belief Govinda

* Percentage of sulphur found = 13.69 ; the calculated amount being 13.79 ; not a trace of gold could be detected.

† The following *Slokas* are cited from *Śaṅkara-digvijaya* in support of the above :—

तस्मादहमित्यतद्वरचो गुहाया दारि मृगुजयदुपेक्ष स संकराद्यः ।
आचार इत्युपदिष्टं स तत्र तर्कं नीतिव्यमादयुरवे न मुच्यंतीनाम् ॥

should no doubt be placed in the 8th century A. D. Apart altogether from the question whether at such an early date the progress of chemical knowledge as revealed in *Rasahridaya* had been attained in India, the colophon at the end of the work would tell against such an hypothesis (Intro. liii). The author distinctly states that he wrote his book under the auspices of the king of the *Kirātas* and even throws out a hint that he was of the Buddhist persuasion. We have no valid reasons to believe that *Saṅkara*, the sturdy champion of Brahminical faith and the mighty dialectician, whose activity proved the ruin of Buddhism in India should have sat at the feet of a Guru of the opposite creed.

न्यासः पराशरमुक्तः शिवसूत्रव्याख्यानः सकमुनिः शिवितानुभावः ।
नान्दधत्तानुपगतः किल गौडपादी श्रीविद्यायमुक्तिरस्य च विद्यमुक्तः ॥
इत्याह तस्य निकटे किल प्रःस्तुतार्त्तं * * * *

श्रीमच्छंकरदिग्विजयः, ५मसर्गः, verses १०१ and १०५-६ ।

श्रीविद्यायमर्कस्तनयव्याख्यानः—दशमः १२ ।

In the above *Slokas* *Govindanātha Muni* is stated to be the preceptor of *Saṅkara*, the former being himself the pupil of *Gaudapāda*, who in his turn was a pupil of *Sukadeva*, son of *Vyāsa*, the well-known compiler of the *Vedas*. The *Govindanātha* of the text has been confounded by the commentator, *Dhyanapāti Śrī* with the Buddhist *Govinda*. It is scarcely necessary to take serious notice of the chronological perspective of the author of the *Saṅkaradiḡvijaya*.

**The Mechanical, Physical and
Chemical Theories of the
Ancient Hindus.**

(By Principal B. N. Seal.)

I propose in this paper to give a synoptic view of the mechanical, physical and chemical theories of the ancient Hindus. A chronological survey, even if the materials for it were available, would be here of little account. The origins of Hindu natural philosophy in the speculations of the Brāhmanas and the Upanishads, or in the mythology of the Purānas, however interesting from the standpoint of '*cultur-geschichte*,' do not come within the scope of the present exposition, which relates to the result of systematic thought as directed to the phenomena and processes of Nature. I have therefore confined myself to an account of natural philosophy as expounded in the principal systems of Hindu thought. The Sāṅkhya-Pātañjala system accounts for the Universe on principles of cosmic evolution, the Vaiśeṣika-Nyāya lays down the methodology of science, and elaborates the concepts of mechanics, physics and chemistry. The Vedānta, the Pūrva-Mīmāṃsā, and in a less degree, the Banddho, the Jaina, and the Chārvāka systems, make incidental contributions on points of special interest, but their main value in this regard is critical and negative. The principal authorities

followed in this account,—the Vyāsa Bhāṣya on Patañjali's sūtras, the Saṃhitā of Charaka, the Bhāṣya of Prasastapāda, the Vārttika of Uddyotakara, and the Vṛihat Saṃhitā of Varāhamihira,—all centre round the Hindu Renaissance, the beginnings of the anti-Buddhist reaction, in the fourth, fifth and sixth centuries of the Christian era. Whenever I have made use of later authors, e. g. Kumārila, Saṅkara, Śrīdhara, Vāchaspati, Udayana, Bhāskara, Jayanta, Varvara, Raghunātha, Viṣṇuabhikṣu &c. I have taken care to see (except where the opposite is expressly mentioned) that no idea is surreptitiously introduced which is not explicitly contained in the earlier authors.

The Sāṅkhya-Patañjala System.—This system possesses a unique interest in the history of thought as embodying the earliest clear and comprehensive account of the process of cosmic evolution, viewed not as a mere metaphysical speculation but as a scientific principle based on the conservation, the transformation, and the dissipation of Energy.

Prakṛiti—the ultimate ground:—The manifested world is traced in the Sāṅkhya to an unmanifested ground, Prakṛiti, which is conceived as formless and undifferentiated, limitless and ubiquitous, indestructible and undecaying, ungrounded and uncontrolled, without beginning and without end. But the unity of Prakṛiti is a mere abstraction; it is in reality an undifferentiated

manifold, an indeterminate infinite continuum of infinitesimal Reals. These Reals, termed *Gunas*, may by another abstraction be classed under three heads, (1) *Sattva*, the Essence which manifests itself in a phenomenon, and which is characterised by this tendency to manifestation, the Essence, in other words, which serves as the medium for the reflection of Intelligence, (2) *Rajas*, Energy, that which is efficient in a phenomenon, and is characterised by a tendency to do work, or overcome resistance, and (3) *Tamas*, mass or inertia, which counteracts the tendency of *Rajas* to do work, and of *Sattva* to conscious manifestation.

The ultimate factors of the Universe, then, are (1) Essence, or intelligence-stuff, (2) Energy, and (3) Matter, characterised by mass or inertia.

These *Gunas* are conceived to be Reals, substantive entities,—not however as self-subsistent or independent entities,—(*स्वात्म*), but as interdependent moments in every Real or substantive Existence. •

Even Energy is substantive in this sense. The infinitesimals of Energy do not possess inertia or gravity, and are not therefore material, but they possess quantum and extensity (*परिमाण—परिच्छिन्न*).

The very nature of Energy is to do work, to overcome resistance (*रजसवत् कर्मकार*), to produce motion. All Energy is therefore ultimately kinetic. Even potential Energy (*अनुरूपव्यय*) is only the Energy of motion in imperceptible forms.

The original constituents and their interaction. Every phenomenon, it has been explained, consists of a three-fold *arche*, intelligible Essence, Energy, and Mass. In intimate union these enter into things as essential constitutive factors. The essence of a thing (*sattva*) is that by which it manifests itself to intelligence, and nothing exists without such manifestation in the Universe of Consciousness (*समस्तबुद्धि*). But the Essence is only one of three moments. It does not possess mass or gravity, it neither offers resistance, nor does work. Next there is the element of *Tamas*, mass, inertia, matter-stuff, which offers resistance to motion as well as to conscious reflection. (*तमः शुद्ध वस्तुत्वम्*)

But the intelligence-stuff and the matter-stuff cannot do any work, and are devoid of productive activity in themselves. All work comes from *Rajas*, the principle of Energy, which overcomes the resistance of matter, and supplies even Intelligence with the Energy which it requires for its own work of conscious regulation and adaptation. (*अज्ञानाभावात् अहङ्काराभावात् सकार्यविग्रहे राजसाहङ्कारः सहकारी सत्यं लोकाभावे-सत्त्ववश-अविग्रहश्च ।*)

The *Gunas* are always uniting, separating, uniting again. (*अन्वेषनिष्ठताः शुद्धाः, नैवास्मिन्मयानां विद्येते वा सम्भवन्ते*). Everything in the world results from their peculiar arrangement and combination. Varying quantities of Essence, Energy and Mass, in varied groupings, set on one another, and

through their mutual interaction and interdependence evolve from the indefinite or qualitatively indeterminate to the definite or qualitatively determinate. (एते गुणः परस्परौपरतन्त्रविभागाः संयोगविभागश्चैव; इतरेतरोपाशयेषु जगत्कर्मतन्मूलेभ्यः ।—आसमाय) But though co-operating to produce the world of effects, these divers moments with divers tendencies never coalesce. In the phenomenal product whatever Energy there is is due to the element of Rajas, and Rajas alone ; all matter, resistance, stability is due to Tamas, and all conscious manifestation to Sattva, (परस्परान्नाद्विभेदेषु च संनिवृत्त्यतिविविधायाः—आसमाय । यतोऽन्नादादिभावेन जगदादितेऽपि इत्येव प्रकाशगुणः सत्त्वसौख्यं क्रियागुणः रजस्तपश्च क्लिप्तियुक्तमसत्त्वं एव—विज्ञानमिच्छा योग्यकारिणं on आसमाय, *ibid*—नेषां गुरुतः संकीर्णत्वे—आसम्यतिष्ठति तत्त्वत्रैवोपरतौ on आसमाय *ibid*)

The nature of the interaction is peculiar. In order that there may be evolution with transformation of Energy, there must be a disturbance of equilibrium, a preponderance of either Energy or Mass-resistance, or Essence over the other moments. The particular Guna which happens to be predominant in any phenomenon, becomes manifest in that phenomenon, and the others become latent, though their presence is inferred by their effect. For example, in any material system at rest, the Mass is patent, the Energy latent, and the conscious manifestation sub-latent. In a moving body, the Rajas, Energy, is predominant (kinetic), while the Mass or rather the Resistance

it offers is overcome. In the volitional consciousness accompanied with movement, the transformation of Energy (or work done by *Rajas*) goes hand in hand with the predominance of the conscious manifestation, while the matter-stuff or *Mass*, though latent, is to be inferred from the resistance overcome. (प्रधानवैश्यायान् उपदर्शितसप्रधाना सुषुप्तेष्वपि च व्यापारमात्रेण प्रधानात्मनोऽतिवृत्तिरिति शङ्काः—व्यासभाष्य)

The starting point. The starting point in the cosmic history is a condition of equilibrium or equipoise consisting in a uniform diffusion of the *Reals*. The tendencies to conscious manifestation as well the powers of doing work are exactly counterbalanced by the resistances of the inertia or *Mass*. The process of cosmic evolution (परिवर्तन) is under arrest. (अन्तरजलमग्नो जलस्यैव सङ्गतः—Pravachana-Sūtra 61, Chap. I. साक्षादस्या चक्षुष्यविरिक्तवस्या चक्षुष्याधिकभावेन अर्हतास्या चक्षुष्या इति शङ्काः—विद्यालक्षण, *ibid*).

Beginning of Evolution. The transcendental (non-mechanical) influence of the *Purusha* (the Absolute) puts an end to this arrest, and initiates the process of creation. Evolution begins with the disturbance of the original equilibrium. How this is mechanically brought about is not very clear. A modern expounder of the *Sāṅkhya* supposes that the particles of *Sattva*, *Rajas*, and *Tamas* possess a natural affinity for other particles of their own class, and that when the transcendental influence of the *Purusha* ends the state of arrest, the

affinity comes into play, breaks up the uniform diffusion, and leads to unequal aggregation, and therefore, to the relative preponderance of one or more of the three Gunas over the others. Thus commences formative combination among the Reals, and consequent productive activity. (ईदृशम् कारणासंयोगः शून्याधिकभावेन चत्वीर्ण संयोगविशेषः । Chap. I, Sūtra 66, प्रवचनसाध—विज्ञानसिद्धि । पृथिवीत्यन्तीनां पृथिवीत्यन्तैश्च सत्त्वत्यन्तीनाम् एकतातीव्यतया एकता । अन्तातीव्योपस्थादिना तद्विज्ञानादिकं च युक्तम् ibid., Sūtra 128, Chap. I).

*Formation of wholes or systems—collocation of Reals :—*Creative transformation accompanied with evolution of motion (परिचल) and work done by Energy (क्रिया) cannot take place without a peculiar collocation of the Reals (Gunas). To form wholes or systems (समुदय) it is essential that one Guna should for the moment be preponderant, and the others co-operant. And this cannot be without an unequal aggregation which overthrows the original equilibrium (सुवैद्यम्, शून्याधिकभाव),—in other words, without unequal forces or stresses coming into play in different parts of the system. (सुवचिर्ण—वाचस्पति ।) अर्थात् सक्रिय परिचलनवत्.....समुदयः सम्भवति । यच्च सुवचिर्णं सुवचिर्ण-भावमनर्णं न सम्भवति । न सुवचिर्णान्तातीव्यो वैद्यम् विना । न च वैद्य-सुवचिर्णविसर्गकभावोदये । (वाचस्पति, कौमुदी on kārīkā 16.)

*The Formula of Evolution—*Differentiation in Integration.—Evolution (परिचल) in its formal aspect is defined as differentiation in the integrated (संघट-

विवेक). In other words, the process of Evolution consists in the development of the differentiated (वैचल्य) within the undifferentiated (सामान्यता), of the determinate (निश्चित) within the indeterminate (अनिश्चित), of the coherent (सुसंविद्ध) within the incoherent (असुसंविद्ध). The evolutionary series is subject to a definite law which it cannot overstep (परिचालननियमन). The order of succession is not from the whole to parts, nor from parts to the whole, — but ever from a relatively less differentiated, less determinate, less coherent whole to a relatively more differentiated, more determinate, more coherent whole. That the process of differentiation evolves out of homogeneity separate or unrelated parts, which are then integrated into a whole, and that this whole again breaks up by fresh differentiation into isolated factors for a subsequent reintegration, and so on *ad infinitum*, is a fundamental misconception of the course of material Evolution. That the antithesis stands over against the thesis, and that the synthesis supervenes and imposes unity *ab extra* on these two independent and mutually hostile moments is the same radical misconception as regards the dialectical form of cosmic development. On the Sāṅkhya view, increasing differentiation proceeds *pari passu* with increasing integration within the evolving whole, so that by this two-fold process what was an incoherent indeterminate homogeneous whole

evolves into a coherent determinate heterogeneous whole.

The different stadia in the order of cosmic Evolution are characterised as follows :—

- (1) The inconceivable, the unknowable, the formless, of which no character can be predicated (अविद्य), including Prakriti, or the Reals in a state of equilibrium.
- (2) The knowable, the empirical universe, cosmic matter of Experience, things as matter or stuff of consciousness (विद्य),—comprising Mahat, the intelligible Essence of the cosmos, evolved by differentiation and integration within the formless, characterless, inconceivable Prakriti.
- (3) Individuated but still indeterminate stuff bifurcating into two series—Subject-experience and Object-experience,—comprising on the one hand the indeterminate unity of apperception or the empirical Ego, as the co-ordinating principle of Subject-series (अविद्य), and on the other hand, the indeterminate material potencies, the subtle vehicles of potential Energy (सूक्ष्म, सूक्ष्म), the ultimate subtle constituents of the Object-series (the material world). The previous stadium, the cosmic matter of Experience (विद्य, सूक्ष्म) evolves within itself,

by differentiation and integration, an individuated but still indeterminate stuff in two co-ordinated series, Subject and Object.

- (4) Determinate stuff (निश्चित) evolved within the indeterminate by further differentiation and integration, viz., in the series of Subject-experience, sensory and motor stuff ; and in the Object series, a corresponding atomic matter-stuff actualising the material potencies in the form of specific sensible Energies. The latter includes the different classes of Paramāṇus, the different kinds of atomic constituents of different kinds of gross matter (सूक्ष्मद्रव्य).
- (5) Coherent and integrated matter-stuff, individual substances, characterised by generic and specific properties, which however are not rigidly fixed, but fluent being subject to a three-fold change and constantly evolving, (अद्वयसत्त्वावयवमेवाद्वयतः समुच्चः द्रव्यमिति पदचक्षति—व्यासभाष्य, Sūtra 44, Chap. III. सामान्यनिश्चयसमुदायी इत्यर्थ—व्यासभाष्य, *ibid.*, सामान्यनिश्चयात्मानवी धर्मोऽयं, *ibid.*, धर्मिणो धर्मोऽलसत्त्वावयवपरिणामः).
- (6) And so the cosmic series moves on in ascending stages of unstable equilibrium (निवृत्तसत्त्वपरिणाम) until the reverse course of equilibration and dissipation of Energy

(सद्मनपरिणाम and द्वाव्यवस्था) which even now constantly accompanies the evolution and transformation of Energy, completes the disintegration of the universe into its original unmanifested ground, the unknowable Prakriti.

The order of Cosmic Evolution according to the आसुभाष्य (Śūtra 19, Pāda II) is shown below, in a tabular form :—

Prakriti, the unmanifested unknowable ground
(दृढसम्यक्तन्त्रित्व)

Cosmic matter of experience (अद्वैत, लिङ्ग)

Subject series (अविज्ञेय)	Object series
Individuated indeterminate mind-stuff	Individuated i.e. determinate matter-stuff
(unity of apperception	(subtile material potencies, सत्त्वत्व)
empirical Ego, अविज्ञा)	

Determinate mind-stuff	Determinate matter-stuff
(विज्ञेय) sensory and	(विज्ञेय) atomic and molecular psychoses, etc.
(आनेन्द्रिय, कर्मेन्द्रिय and मनः)	matter (परमाणु—सूक्ष्मसूत)

Coherent and integrated matter-stuff (अयुक्तसिद्धादयः समूहः सत्तातः द्रव्यं)

Individual substances, with generic and specific characters subject to constant change or evolution e.g. inorganic objects composed of atoms or molecules (परमाणु), vegetable organisms (पच), animal organisms (पशूँर) (अयुक्तसिद्धादयः सङ्घातः शरीरं पचः परमाणुविति—व्यासभाष्य, Sūtra 44, Pāda III).

तत्र तत् सङ्घट्टं विविच्यते कमानतिष्ठते, तथा सङ्घट्टविशेषाः निरुद्धमात्रे संसृष्टा विविच्यन्ते, परिणामक्रमनिष्ठमात्रं, तथा तेषु अविशेषेषु सूतेन्द्रियाणि संसृष्टानि विविच्यन्ते, न विविच्यन्ते; परं तन्मात्रमस्ति तेषाम् अमूल्यवशादस्मादपरिचया व्याख्यासिद्धते (व्यासभाष्य, Sūtra 19, Pāda II).

N.B.—The usual order given in the Sāṅkhya compendiums is as follows :—Prakṛti, Mahat, Ahaṅkāra,—and then the bifurcation, viz., 11 organs sensory, motor and common sensori-motor from Rājasic Ahaṅkāra, and Tanmātras from Tāmasic Ahaṅkāra, —and finally the Paramānūs of the Sthūla-Bhūtas.

The conservation of Energy (and of Mass)—the transformation of Energy :—

The Gunas (Reals), though assuming an infinite diversity of forms and powers, can neither be created

nor destroyed. The totality of the Mass (Tamas), as well as of Energy (Rajas) remains constant, if we take account both of the manifested and the unmanifested, the actual and the potential. But the individual products of the evolutionary process, the concrete phenomenal modes resulting from the combined action of the original Mass, Energy and Essence, are subject to addition and subtraction, growth and decay, which are only due to changes of collocation, and consequent changes of state from the potential to the actual, (in other words, from the future to the present and from the present to the past, in a time series)—changes, which are illusorily ascribed to the Reals themselves. The different collocations of Mass and Energy give birth to the divers powers of things, the various forms of Energy which may be classed as like and unlike ; indeed the course of Evolution from the Reals conforms to a fixed law, not only as regards the order of succession, but also as regards the appearance (and mutual relations) of like and unlike Energies. And this transformation is constantly going on,—the course of Evolution is not arrested for a moment.

गुणान् सूर्यधर्मोद्गुणातिनः न प्रत्यक्षमवस्थाने नोपलब्धवन्ति नानुभूतिरिव
अतीताद्गतान्तव्यवस्थामवस्थीभिः गुणानुभूतिभिः उपलब्धमापाद्यधर्मिका इव
प्रत्यक्षमावस्थाने (व्यासभाष्य, Sūtra 19, Pāda II). परिणामनिवृत्त्या
गुणानाम् । सूर्यधर्मिणं गुणानां सन्निवेशविशेषमावस्थानम् (*ibid*, Sūtra
13, Pāda IV). एते गुणाः तुल्यजातीयातुल्यजातीयव्यक्तिभेदादुद्गुणातिनः
(*ibid*, Sūtra 19, Pāda II). परिणामकमवस्थानम् (व्यासभाष्य,

Sūtra 19, Pāda II), कर्मात्मनो परिणामात्मनो हेतुः. (*Paśāñjali* Sūtra 15, Pāda III), वक्रतिः परिणमनशीला अचक्षुष्यपरिणम्य नान्वतिहेतुः ।

The doctrine of Causation, a corollary from the conservation and transformation of Energy :—the principle of collocation—the storing-up and the liberation of Energy :—

The Sāṅkhya view of causation follows at once as a corollary from this doctrine of the conservation and transformation of Energy. As the total Energy remains the same, while the world is constantly evolving, cause and effect are only more or less evolved forms of the same ultimate Energy. The sum of effects exists in the sum of causes in a potential (or un-evolved) form. The grouping or collocation alone changes, and this brings on the manifestation of the latent powers of the Guṇas but without creation of anything new. What is called the (material) cause or sum of material causes is only the power which is efficient in the production or rather the vehicle of the power. This power is the unmanifested (or potential) form of the Energy set free (*व्यङ्ग्य*) in the effect. But the concomitant conditions are necessary to call forth the so-called material cause into activity. When the favourable combination or co-operation of concomitants is wanting, there is no manifestation of the effect. The question is—what is the aid which the concomitant conditions render to the deter-

mination (and production) of the effect existing in potency in its material cause ? First there is the merely mechanical view as illustrated by some commonplace examples, *e.g.*, the manifestation of the figure of the statue in the marble block by the causal efficiency of the sculptor's art, or of the oil in the sesamum by pressing, or of the grain of rice out of the paddy by the process of husking. In these cases the manifestation of an effect is only its passage from potentiality to actuality, a stadium in the process of evolution from possible (future) existence to actual (present) existence ; and the concomitant condition (सदकारिणि) or efficient cause (निमित्तकारण), the sculptor's chiselling, the pressing, the husking, is a sort of mechanical or instrumental help to this passage or transition. कार्यवन्तिमलमेव संपादान-कारणतम् । सा शक्तिः कार्यस्य चनागतवस्था एव । स एव विशेषः (कामनेः वाक् कारणे विशेषः) चनाभिः कार्यस्य चनागतवस्था इत्युच्यते (विज्ञानभिक्षु-प्रवचनभाष्य, Sūtra 115, Chap. I). अभिव्यक्तिः वर्तमानवस्था । कारणव्यापारोऽयं कार्यस्य वर्तमानलक्ष्यपरिणाममेव जनयति । यथा मिष्टानमध्यस्वप्रतिमायाः सैद्धिक-व्यापारिण्य अभिव्यक्तिमात्रं तिलकृतैलस्य च निष्पीडनेन धान्यकृततण्डुलस्य च चवचनेन (विज्ञानभिक्षु-प्रवचनभाष्य, Sūtra 129, Chap. I).

These mechanical examples of the Kapila-Sāṅkhya have the merit of simplicity, but the Patañjali-Sāṅkhya brushes them aside, and explains causation on the basis of the conservation and transformation of Energy, advancing it as the liberation of potential Energy existing

stored up in a *Guna* collocation, (the sum of material causes) the liberation following on the action of the proximate efficient cause, or concomitant condition (निमित्तकारण).

The causal operation of concomitant conditions (efficient causes) lies only in this that they supply a physical stimulus which liberates the potential Energy stored-up in a given collocation. Everything in the phenomenal world is but a special collocation of the ultimate Reals (Energy, Mass and Essence). The sum of (material) causes potentially contains the Energy manifested in the sum of effects; and in the passage from potency to actualisation, the effectuating condition (the concomitant cause) when it is itself accomplished, is only a step in the evolutionary series, which adds a specific stimulus, and renders determinate that which was previously indeterminate. When the effectuating condition is added to the sum of material conditions, in a given collocation, all that happens is that a stimulus is imparted, which removes the arrest, disturbs the relatively stable equilibrium, and brings on a liberation of Energy (सद्गुणनिर्गमि) together with a fresh collocation (गुणसन्निवेशविशेषः). सर्वमिदं गुणानां सन्निवेशविशेषमात्रम् इति परमाद्यन्ती गुणाद्यानः (व्यासभाष्य, Sātra 13, Pāda 1V). सततं कलम निमित्तं वर्तमानोक्तरी समये न अपूर्वोपपन्नते । निरुद्धं निमित्तं निमित्तकारणं विशेषादुक्तव्यं ब्रह्मे । व्याससुब्रह्मसूत्रे (व्यासभाष्य, Sātra 12, Pāda 1V).

Describing the production of bodies ('organic vehicles') for individual souls, out of matter of Prakṛiti, under the influence of their merit and demerit, as concomitant conditions, Patañjali points out that non-material concomitants like merit and demerit do not supply any moving force or Energy to the sum of material conditions, but only remove the arrest (the state of relatively stable equilibrium) in a given collocation, even as the owner of a field removes the barrier in flooding his field from a reservoir of water. This description is intended to represent the super-physical influence of non-material concomitants (or causes) like volition, merit and demerit, etc., but the causal operation of a material concomitant condition is essentially the same;—there is the same reservoir of stored-up Energy in a given collocation,—the same condition of arrest or relatively stable equilibrium,—the same liberation of the stored-up potential Energy which flows along the line of least resistance,—the only difference being that in the case of material concomitants the stimulus which removes the arrest is physical, instead of being transcendental as in the case of non-material causes like will, merit and demerit, etc.

The Vyāsa-bhāṣya helps us to a clear mental representation of the details of this process, being perhaps the finest example before Newton of the exercise of a Scientific Imagination, and as memor-

able as any in the whole history of thought containing as it does the theory of potentials as in a nutshell :—As the owner of many fields can irrigate, from a field which is already flooded, others of the same or a lower level, without forcing the waters thereto with his hands, and merely by making an opening in the barrier or dyke, on which the waters rush in by their own force ;—or further, as the same person cannot force these waters, or the earthy matters held in solution therein, into the roots of the rice plants, but only removes the obstructive grasses and weeds, on which the fluids of their own power enter the roots ;—such is the action of an effectuating condition (निमित्त) added to a sum of material causes or conditions.

निमित्तम् चक्षुर्लोकं प्रपद्यीत वरपलेदस्य वदः चेत्तिक्रवत् (*Patañjali Sūtra 3, Pāda IV*). न हि चक्षोर्दि निमित्तं यथा चेत्तिकः केदारान् अपां पूरयान् केदारं पिशाचयितुः इत्थं निमित्तं वा निमित्ततरं वा नापः पाणिनापकर्षति चःवरसं तु चाक्षां निमित्तं तस्मिन् भित्ते सद्यमेवापः केदराकरम् आश्रावयति ।

Chain of Causation—fixed order.—The order of Evolution with the transformation of the Energies follows a definite law. The unalterable chain of causes and effects in the phenomenal world illustrates this fixed order. But though the cosmic order is one and fixed, it comprehends divers series arising from different combinations of the original Gunas, which constitute subordinate or particular laws of cause and effect (कर्मान्वलं परिणामान्वले हेतुः, *Patañjali Sūtra 15, Pāda III*).

What we call the qualities of things are only modes of Energy acting in those collocations. *वीज्यमात्राच्छिद्राः शक्तिवः शक्तिरित्थं च*—इति कृष्णप्रसन्नमिहानुमिरुक्तम् (आसुभाष्य, Sūtra 14, Pāda III). ते खल्वनी चर्मा वर्तमाना व्याज्जालः, अतीताज्जालाः, दृक्काज्जालः, सत्येतिदं गुणानां सतिवेद्यमात्रमिति परमाद्यनी गुणज्जालः (आसुभाष्य, Sūtra 3, Pāda IV). And these various Energies are sometimes actual (kinetic), sometimes potential, rising to actuality, and sometimes sublatent, subsiding from actuality into sublatency. In fact, the original Energy is one and ubiquitous, and everything therefore exists in everything else, *potentialiter* (सर्वं सत्त्वात्मकमिति), without prejudice to the generic and specific differences of things (जात्यनुच्छेदेन सर्वं सत्त्वात्मकं). Inorganic matter, vegetable organisms, and animal organisms are essentially and ultimately one (जलसूक्ष्मोऽपरिणामिको रसादिवैकल्यं स्वादेरेषु दृष्टं तथा स्वादेराद्यो जलमेव जलमानां स्वादेरेषु) so far as Mass and Energy are concerned, but the varied forms of Energy and the generic and specific qualities (or properties) of things, which are but modes of Energy, follow a definite unalterable law in the order of their appearance and succession, under conditions of space, time, mode and causality, and hence all effects do not manifest themselves at once ईशकालाकारनिर्दिष्टापवत्यात् न खलु समानकालम् आत्मनामिच्छतिः (ibid., Sūtra 14, Pāda III). यो यस्य चक्षुष्य समनकरी चक्षुः स तस्य जलः । दिव्यः प्रकाशो घट उपजायते रति चन्दनपत्रादिफलः । खल्वद्यपिजातक्रमः घटस्य अनागतभावान् वर्तमानभावकालः, तथा दिव्यस्य वर्तमानभावात् अतीतभावकालः (आसुभाष्य, Sūtra 15, Pāda III).

Time, Space, and the Causal series :—

A *Tanmātra* (infra-atomic particle of subtile matter) is conceived by our understanding to stand in three relations—(1) position in Space (स्थानवच्छिन्न), (2) position in the Time-series (कालवच्छिन्न) and (3) position in the causal series (निमित्तवच्छिन्न).

These three relations are the work of the intuitive stage of knowledge as opposed to the conceptual (निमित्तकत्ववच्छिन्न as opposed to सवित्तकत्ववच्छिन्न). But this is not the pure relationless intuition of Reality (निमित्तवच्छिन्न निमित्तकत्ववच्छिन्न) which may be termed intellectual intuition, but the intuition that imposes its forms on the Real substrate (सवित्तवच्छिन्न निमित्तकत्ववच्छिन्न) or in other words empirical intuition. तत्र भूतसूक्ष्मेण सञ्चितकर्मक्षेत्रेण ईशकालनिमित्तानुभववच्छिन्नेषु या समापत्तिः सा सविद्याय अनुचरति । तथापि एकद्विनिर्गमनेन सदितकर्मवच्छिन्नं भूतसूक्ष्मात्मत्वमीश्वरं समाधिपदायानुपनिब्रजे (व्यासभाष्य, Sôtra 44, Pâda I).

Infinite Time is a non-entity objectively considered, being only a construction of the Understanding (इद्विनिर्गम) based on the relation of antecedence and sequence in which the members of the phenomenal series are intuited to stand to one another. These phenomenal changes as intuited by us in the empirical consciousness fall into a series, which the Understanding conceives, as order in Time. The Time-series, then, is a *schema* of the Understanding for

representing the course of Evolution. The *schema* of the Understanding supervenes on the phenomenal world as order in time, and hence in the empirical consciousness the Time-series appears to have an objective reality, and to form a continuum. As there is an ultimate and irreducible unit of extensive quantity (अवकाश) in the *Gunas* or infinitesimal Reals of *Prakriti*, which are without constituent parts, so the moment may be conceived as the ultimate and irreducible unit of this time-continuum as represented in the empirical consciousness. A moment therefore cannot be thought of as containing any parts standing in the relation of antecedence and sequence. If change is represented by the Time-series, a moment as the unit of time may be supposed to represent the unit of change. Now all physical change may be reduced to the motion of atoms in Space, and we may therefore define the moment as representing the ultimate unit of such change—*viz.*, the (instantaneous) transit of an atom (or rather a *Tanmātra*) from one point in Space to the next succeeding point. Even an atom has constituent parts (the *Tanmātras*), and hence an atom must take more than one moment to change its position. The motion of that which is absolutely simple and without parts from one point in Space to the next must be instantaneous, and conceived as the absolute unit of change

(and therefore of time, कथं). If this is held to be an irreducible absolute unit, it will follow that what we represent as the time-continuum is really discrete. Time is of one dimension. Two moments cannot co-exist. Neither does any series of moments exist in reality. Order in Time is nothing but the relation of antecedence and sequence, between the moment that is, and the moment that went just before. But only one moment, the present, exists. The future and the past have no meaning apart from potential and sublatent phenomena. One kind of transformation, to which a thing is subject, is that it changes from the potential to the actual, and from the actual to the sublatent. This may be called the change of mark (लक्षणापरिणाम) as opposed to change of quality (गुणपरिणाम), and the change due to duration or lapse of time (अवस्थापरिणाम). The present is the mark of actuality,—the future, the mark of potentiality,—and the past, of sublatency,—in a phenomenon. Only one single moment is actual, and the whole Universe evolves in that one single moment. The rest is but potential or sublatent.

अथ तत्त्वज्ञानयोगीति वस्तुसमाहार इति बुद्धिसमाहारः सुहृन्मोक्षोपायद्वयः । स सुखस्य कारणः वस्तुस्यैव बुद्धिसमाहारः अवस्थानः सुमासी लौकिकानां बुद्धिस्तदर्थमासी वस्तुसङ्घ उप अवभासते । अथानु वस्तुपरितत्त्वज्ञानावस्थायी । ज्ञानव्यवधानकव्याख्या । न कालविदः काल इति आशयते योगिनः । न च हो लघौ सङ्ग भवतः, ज्ञानव न वयोः सङ्गमुदीरसम्भवान् पृथक्कः दुर्गरभाविनी यदात्मन्यै अवस्था स कालः । तस्मान् वर्तमानं पदेनः अथः न पृथ्वीतरवस्थाः

सन्धीति तस्याप्राप्तिं तद्व्यवहारः । त्वे तु भूतमाविनः सत्ताः ते परिणामावितः
व्याख्येयाः । तन्मेवेन चयेन कृतस्यो लोकः परिणामस्तनुमवति, तनुचयाददः
स्तुत्यस्यो भवेत् । यथाऽपकर्षदर्थेन द्वयं परमाद्यः एव परमापकर्षदर्थकः
कालः सत्ताः । यावता वा समयेन चलितः परमाद्यः पूर्वदिशं ज्ञातुं
उत्तरदिशम् उपसम्बन्धेन वा कालः सत्ताः तद्व्यवहारविषयेदस्य कालः । (आद्यमाद्य
Sutra 52, Pada III.)

Vijñāna-bhikṣu points out that this does not amount to a denial of Time. It means that time has no real (or objective) existence apart from the 'moment'. But the latter is real, being identical with the unit of change in phenomena (गुणपरिणामस्य सत्त्व-वचनम्). But even this is real only for our empirical (relative) consciousness (अनुसिद्धदर्शन), which intuits the relation of antecedence and sequence into the evolving Reals (Gunas), in the stage of 'empirical intuition' (सन्धिचारा निर्बिकल्पवस्था). The 'intellectual intuition' (निर्विचारा निर्बिकल्पवस्था) on the other hand, apprehends the Reals as they are, without the empirical imported relations of Space, Time and Causality.

Space as extension and Space as position :—

Space must be distinguished as *Deśa* (locus, or rather extension) and *Dik* (relative position). Space (*Dik*) as the totality of position, or as an order of co-existent points, is wholly relative to the Understanding, like order in time, being constructed on the basis of relations of position intuited by our empirical (or relative) consciousness. But there is this difference between Space-order and Time-order :—there is no unit of Space as position (*Dik*),

though we may conceive a unit of Time, viz., the moment (*akṣa*) regarded as the unit of change in the phenomenal or causal series (*परमाणुक्रिया* or *पञ्चपरमाण्वक्ष* *चक्रवर्त्तनम्*—योगवार्त्तिक, Sūtra 51, Pada III). Spatial position (*Dik*) results only from the different relations in which the all-pervasive *Akāśa* stands to the various finite (or bounded) objects. On the other hand, Space as extension or locus of a finite body, *Desa* (*देशः स्थानाधारः*), has an ultimate unit, being analysable into the infinitesimal extensive quantity inherent in the *Reals* (*Gunas*) of *Prakṛiti*. (*पञ्चपरमाण्वक्षवर्त्तनम्*—योगवार्त्तिक : *यद्वैतं निश्चयादिनापि चमत्काराधिक्ये व्याख्याता, कामाक्षीति दिव्यवह्मराभावात्। यूर्वादिब्यवहारस्य दिगुपर्याधित्वेन सप्तधात्वाभावात्। काकदिग्व्यवहारस्येति चाकाशादेव तदुपपत्तेः। कालास्य दिग्दर्शनिशेषः यत् कालः सप्तद्वय इत्यने, दिक् तु सूर्यदेव नैत्यने।*)

The Casual series.—The relation of Cause and Effect has been already explained. It only remains to add that the category of causality is mediated through the *schema* of order in Time. The Empirical Intuition first superimposes relations of antecedence and sequence on changing phenomena (the evolving *Gunas* or *Reals*), and the Understanding out of these relations creates order in Time. The Empirical Intuition then intuits the phenomenal series of transformations of Energy in this Time-order and in so doing, imports the relation of cause and effect into the course of Nature. (*कारणकारव्यवसायीनां पञ्चवर्त्तनम्*—योगवार्त्तिक, Sūtra 51, Pada III).

The dissipation of Energy (and of Mass)—their dissolution into the formless Prakriti:—Cosmic Evolution (वर्णन) is a two-fold process, creative as well as destructive, dissimilative as well as assimilative, katabolic as well as anabolic (चतुर्लोकसर्ग and विद्वत्सर्ग, विशदयपरिणाम and सहायपरिणाम). In one aspect, there is the aggregation (unequal aggregation) of Mass and Energy, with consequent transformation of Energy, resulting in the creation of inorganic as well as organic matter, and the genesis of worlds. The successive steps of this process may be described as (1) unequal aggregation with storing-up of Energy in a certain collocation, under a state of arrest (i. e., in a state of relatively stable equilibrium), (2) a stimulus removing the arrest, and disturbing the equilibrium, and (3) liberation of the Energy, moving on to a fresh collocation, fresh aggregation, arrest and equilibrium. The process of the world thus moves on from equilibrium to equilibrium, and the result of that process is the development of a coherent determinate heterogeneous whole (जगत् अविवेक विवेक, चतुर्लोकसर्गपरिणाम, विद्वत्सर्गपरिणाम) in what is essentially an incoherent indeterminate homogeneous whole (अजगत्).

But there is a second aspect of this evolutionary process. Unequal aggregations are unstable, there is a constant tendency in things to go back to the original stable equilibrium,

the state of uniform equal diffusion of Reals. This process is called the resolution of like to like (सद्व्यवस्थितम्), consisting in assimilation and dissipation, and being the exact opposite of the process of "differentiation in the integrated" which has evolved the Cosmos. The collocations of Mass, Energy and Essence are always breaking up, and the Energy as well as the Mass, however slowly, however imperceptibly, are being dissipated, i. e., dissolved into the original formless Prakṛti, a state of permanent equilibrium and arrest, from which there is and can be no return, except under the transcendental influence of the Absolute at the commencement of a new creative cycle. Not that there is a destruction of the Mass or Energy, but a dissipation or dissolution into a condition of equal uniform diffusion from which there is no return. This is not the phenomenon of kinetic Energy disappearing and becoming potential or sublatent, for in such cases there is restitution or reconversion by natural means. When this reverse current of assimilation (and dissipation) prevails over the current of dissimulation (and integration), the Universe will disintegrate more and more, until it disappears in the formless Prakṛti, its unknowable source and ground (अज्ञान and कौमुदी).

The Evolution of matter (अवस्थासु सति) :—

The ultimate constitution of Matter is a question

jala system. Three stages clearly stand out in the genesis of Matter :—(1) the original infinitesimal units of Mass or inertia, absolutely homogeneous and ubiquitous, on which Energy does work, when the original equilibrium comes to an end (सूक्ष्मज्ञादिकार), (2) The infra-atomic unit potentials, charged with different kinds of Energy, which result from the action of Energy on the original units of Mass, (तन्मात्र), and (3) the five different classes of atoms, the minutest divisions of which gross matter is capable, but which are themselves complex Tanmātric systems (सूक्ष्मभूतपरमाणु).

The first stadium Bhūādi is absolutely homogeneous and absolutely inert, being devoid of all physical and chemical characters (स्वादिभिरसंयुक्तं) except quantum or mass (परिच्छिन्नत्व, परिमाण); and this admits neither of addition nor of subtraction, can neither be created nor destroyed. The second stadium Tanmātra represents subtle matter, vibratory, impingent, radiant, etc., instinct with potential energy. These potentials arise from the unequal aggregation of the original mass-units in different proportions and collocations with an unequal distribution of the original Energy (Rajas). (तन्मात्रं स्वादिः किं कारणम् इति चेत् सकारणद्रव्याणां सूक्ष्मविक्रमार्थेन चतुर्विधं इति संकीर्णविशेष एव—संज्ञातीयेष्ववस्थाभिः इन्द्रियाणादिकं च युक्तं.) The Tanmātras possess something more than quantum of Mass and Energy. They possess physical characters, some of them penetrability

(अवकाशदान), others powers of impact or pressure, others radiant heat, others again capability of viscous and cohesive attraction. In intimate relation to these physical characters they also possess the potentials of the energies represented by sound, touch, colour, taste and smell, but being subtile matter they are devoid of the peculiar forms (विशेष) which these potentials assume in particles of gross matter like the atoms and their aggregates. In other words, the potentials lodged in subtile matter must undergo peculiar transformations by new groupings or collocations to be classed among sensory stimuli,—gross matter being supposed to be matter endowed with properties of the class of sensory stimuli, though in the minutest particles thereof the sensory stimuli may be infra-sensible (अतीन्द्रिय but not अदृश्य). (सर्वसौमिक सत्त्वावाः ते च अविशेषिणः । ते च पदार्थाः आनन्दोत्पत्त्यः सुखगत-वृद्धादिविशेषैः शुद्धा एककपत्वात् । तथा च आनन्दविशेषवृद्धादिसत्त्वमेव भूतानां वृद्धादिसत्त्वावयवम् ।)

The Tanuātras, then, are infra-atomic particles charged with specific potential energies,—first, the potential of the sound stimulus is lodged in one class of particles, Tanuātras which possess the physical energy of vibration (परिणम) and serve to form the radicle of the ether atom (आकाशपरमाणु), then the potential of the tactile stimulus is lodged in another class of Tanuātras, particles which possess the physical

energy of impact or mechanical pressure in addition to that of vibration and serve to form the radicle of the gas atom (Vāyu Paramāṇu) ;—next, the potential of the colour stimulus is lodged in a third class of Tanmātras, particles which are charged with the energy of radiant heat and light in addition to those of impact and vibration and serve to form the nucleus of the light and heat corpuscle ; then the potential of the taste-stimulus is lodged in other Tanmātras, particles which possess the energy of viscous attraction, in addition to those of heat, impact and vibration, and which afterwards develop into the atom of water, and lastly, the potential of the smell-stimulus is lodged in a further class of Tanmātras, particles which are charged with the energy of cohesive attraction, in addition to those of viscous attraction, heat, impact and vibration and which serve to form the radicle of the earth-atom.

प्रकृतिविधाः तत्त्वानां प्रवृत्तयानां स्वर्गतयानां प्रवृत्तयानां रसतन्मात्रं
गन्धतन्मात्रं च एकेकविंशत्यनुसङ्गवशात्; प्रवृत्तयः प्रकृतिविधाः । आसन्नमात्रं
Sutra 19 Pada II अङ्गकारात् प्रवृत्तयानां तत्त्वानङ्कारसङ्गकारात्
प्रवृत्तयानां प्रवृत्तयानां स्वर्गतयानां प्रवृत्तयानां एकेकविंशत्यनुसङ्गवशात्
तन्मात्राणि तत्त्वानां (प्रवृत्तयः—Sutra 62, Chap. I).

प्रवृत्तयः प्रकृतिविधाः तत्त्वानां प्रवृत्तयानां स्वर्गतयानां प्रवृत्तयानां रसतन्मात्रं
गन्धतन्मात्रं च एकेकविंशत्यनुसङ्गवशात्; प्रवृत्तयः प्रकृतिविधाः । आसन्नमात्रं
Sutra 19 Pada IV तत्त्वानां गन्धतन्मात्रं स्वर्गतयानां प्रवृत्तयानां एकेकविंशत्यनुसङ्गवशात्
तन्मात्राणि तत्त्वानां (प्रवृत्तयः—Sutra 62, Chap. I).

एकः परिणामः सङ्घटनमायुः तेषां च सङ्घातमादिः, एवं मन्त्ररसो रज्ज्वादिना
 योषाजालीयानां चित्तमायायां तैलीलः तैल्यः सङ्घातिकादिः । एवं
 मन्त्ररसकषायां रज्ज्वायुं वायुः तैल्यः सङ्घातिकादिः । एवं शब्दतन्मायायां
 दृक्कारास्त्रिदशजानां वाक्कायायुः तैल्यः सङ्घातिकादिः ।

विज्ञानमित्रो remarks :—यत्र दृग्गै च यं विज्ञानः शब्दादि-
 तन्मायवयवैर्कादित्यस्यैवा'द्वयद्वयाः पृथिवीत्यादिनामयः सन्ति । (दीपवार्तिक, Sutra 14, Pada IV.)

Before explaining the genesis of atoms, it is necessary to say something about *A'kāśa*, which is the link between the infra-atomic particles (*Tanmātras*), and atoms (*Paramāṇus*). *A'kāśa* corresponds, in some respects to the ether of the physicists and in others to what may be called proto-atom (protyle). In one respect *A'kāśa* is all-pervasive (*विष्णु*), and devoid of the property of impenetrability which characterises even the infra-atomic potential units (*Tanmātras*). In another aspect, *A'kāśa* is described as having originated out of the mass or inertia in *Prakṛiti* (*Bhūtādi*) when the latter became charged with the first potential vibration (the sound-potential). *Vijñāna-bhikṣu* in the *Yoga-Vārtika* boldly tackles the difficulty. *A'kāśa*, he explains, has two forms, original and derivative, non-atomic and atomic. The original *A'kāśa* is the undifferentiated formless *Tamas* (mass in *Prakṛiti*, matter-radiment—*Bhūtādi*) which is devoid of all potentials, and is merely the all-pervasive seat or vehicle of the ubiquitous original Energy (*Rajas*). This *A'kāśa*

must not be confounded with vacuum, which is merely negative (आवकाश—un-occupiedness), though it must be conceived as all pervasive, occupying the same space as the various forms of gross matter (समानदीर्घकम्—अवकाशसमकम् आकाश—योगवर्तितम्), and therefore devoid of the property of impenetrability (सुर्गतिरासमानदेवत्वं—योगवर्तितम्) which characterises atomic matter. But when the original equilibrium (सामान्यता) comes to an end, unequal aggregations form collocations in different groups and proportions of the three Gunas (सुनाधिकभावेन पृथीत्यं संवीर्यवित्तित्वः सद्गतम्—विद्यानमित्यु, प्रपञ्चभावे and योगवर्तितम्). The transformation of Energy now begins,—working on a collocation of mass (with Essence) (पुष्पाक्षरीय-सम्यक् सद्गतम्—विद्यानमित्यु, योगवर्तितम्); it first gives rise to the sound potential (सम्पन्नमयोन्माद्वैद्यैव परिचक्षति—विद्यानमित्यु) and the atomic A'kâsa (proto-atom, protyle) is but an integration of the original unit of mass charged with this vibration-potential. This vibratory (or rather rotary) ether-atom (आकाशकण) is integrated, limited (परिच्छिन्न) and as such cannot occupy the same space with other (subsequently integratad) atoms. But this proto-atomic integration of A'kâsa (कार्शकाय) is formed everywhere, and itself residing in the ubiquitous non-atomic A'kâsa (कार्शकाय—अवकाशसमकमाकार्य) forms the universal medium in which air or gas atoms, light and heat corpuscles, and other atoms move and float about. (वायोराकाशं) इति हि अवकाशसमकम् 'आकाशं

न स्यात् तदा सूर्यदिव्यं च स्यात् आदित्यं च तन्मन्त्रादिषु बलकेन चादिवैश्वी न स्यात्—
विज्ञानमित्र, योगवार्त्तिक Sutra 40, Pada III. आकाशं च
कार्यकारणद्वयेन विविधम् : तत्र कारणाकाशं मसीमुद्यतिवत्तयेन
व्यवह्रियते । तदानीम् आकाशताव्यस्रकण्ठादिमुद्यतिविद्याभावात् । तत्र
कारणाकाशं सुखान्तरसम्बन्धं संदम्यतः आदी इन्द्रजलनयोऽप्यार्थद्वयेन परिचयने
तत्र च अमुसङ्गतैक इतिवीनदैव महाभूताकाशः अहकारावेष्टया परिणम्य
वायोरावरणम् लभ्यते (विज्ञानमित्र, योगवार्त्तिक, Sutra 41, Pada 111)

*The genesis of the infra-atomic unit-potentials
(Tanmātras) and of the atoms.*

The subject of the genesis and the structure of the Tanmātras and the Paramātras was a fascinating one to these ancient thinkers and a wide divergence of views prevailed. I will here notice several typical views :—those of the Vishnu Purāna, Parāsara, Patañjali and a certain School of Vedantists reported in the सत्त्वनिबन्ध.

1. A famous passage in the Vishnu Purāna explains the genesis and the structure of the Tanmātras and of the Bhūtas (Paramātras) in the following manner :—

The first Tanmātra originated from the rudiment-matter (Bhūtsdi), the individuated but still indeterminate potential-less Mass in Prakṛiti under the action of Energy (उपदेशनः परिणम्यते—उपलब्धमात्र, Sutra 66, Ch. 1.) by a process of disintegration and emanation (विकृत्याणः—विशुद्धराजः—पञ्चविकाराश्चः—व्यासभान, Sutra 14, Pada IV. विकृत्याणाम् विद्वोर्वैतासमाधौ व्यापिता इति

आत्म, योगवर्तिन on *Patanjali's* Sutra.—सनीप्रविन' विकरणमात्र; etc.) in the menstruum, or surrounding medium of the unindividuated Cosmic Mass (Mahat) (सहस्रारः).

This first subtile matter, the first result of 'Mass disintegration' and Energy-transformation, is charged with the sound-potential, the potential of vibration or oscillation (परिचर्य). It is called the sound-potential (सुन्दरसुन्दर).

This is typical of the genesis (and structure) of the other Tanmāstras (kinds of subtile matter). In each of the remaining cases, an atomic Mass charged with actual specific energies (सुन्दरसुन्दर) disintegrates and emanates, and thus evolves a form of subtile matter (a kind of Tanmātra) under the action of Energy, and always in the same menstruum or surrounding medium,—that of Bhūtādi, the super-subtile. Each kind of subtile matter becomes charged with a new potential in addition to the potentials already evolved. The genesis of an atom, Bhūta Paramānu, is a quite different process. Here the unit potential (Tanmātra) receives an accretion of Mass, and by a sort of condensation and collocation evolves an atom (Bhūta-Paramānu).

The genesis and structure of the Tanmāstras and the Bhūta-Paramānus are worked out below :—

1. The super-subtile individuated Mass (rudiment-matter (Bhūtādi), under the action of the

original Energy (रजः) disintegrates and emanates (विकसते) in the menstruum or surrounding medium (समावरण) of Mahat, cosmic super-subtile Mass, and evolves a form of subtile matter (तन्मात्र), which becomes charged with the sound-potential (vibration-potential, परिकण्ड), and is called the unit of sound-potential 'अण्डतन्मात्र'.

2. This subtile matter, the Mass, charged with sound-potential, receives an accretion of Mass from the rudiment-matter (Bhūta) and by condensation and collocation evolves the A'kāsa Bhūta, the atomic A'kāsa, the proto-atom charged with the specific energy of the sound stimulus (actual vibratory motion.) (स एव सुतर्जद, अण्ड-तन्मात्रात् सविहीयात् अण्डगुणकम्, चाकाशं सुतर्जम् । तथा च अहकाराण्डव्यासाभ्यां द्विविधा चाकाशं सज्जते,—वीरवाचिक on the Vishnu Purāna passage, Sutra 14, Pada IV).
3. This proto-atom, the atomic A'kāsa, charged with its actual specific energy, again disintegrates and emanates, under the action of the original Energy, and in the menstruum of the rudiment-matter (super-subtile Mass) and thus evolves another kind of subtile matter (Tanmātra) which becomes charged with the touch-potential (the potential of impact or mechanical pressure

(अवकाश, अहमीकम्) in addition to the sound-potential (vibration-potential—स्पर्शकम्) and is called the unit of touch-potential (स्पर्शकम्).

4. Next, this subtile matter, the mass charged with touch (and sound) potential, i.e., with the potentials of vibration and impact, receives an accretion of mass again from the rudiment-matter (Bhūtādi) and by condensation and collocation, evolves the Vāyu Bhūta, a kind of gaseous matter or air of which the atoms are charged with the actual specific energy of the touch stimulus, i.e., with actual energy of impact in addition to the actual energy of vibratory motion.
5. Next, the atom of Vāyu, so charged with the actual specific energy of impact and vibration, again disintegrates and emanates, under the action of the original Energy, and in the same menstruum or surrounding medium of the rudiment matter (super-subtile Mass—Bhūtādi) and thus evolves another kind of subtile matter (Tanmātra), which becomes charged with the heat-potential (दीप्ति—हृत्—heat-and-light-potential) in addition to the impact-potential and the vibration-potential, and is called the unit of colour-potential (रूपतन्मात्रम्).

6. Now this subtile matter, this radiant matter, charged with light-and-heat-potential, and also with impact and vibration-potential, receives an accretion of Mass again from the rudiment-matter (Bhūti) and by condensation and collocation evolves the Tejas Bhūta, the light-and-heat-corpuscle, which is charged with the specific Energy of the colour-stimulus, *i.e.*, radiates actual heat and light (जलम् in addition to manifesting the energy of impact (impingency) and of vibration (or oscillation).
7. Next, this atom or light-and-heat-corpuscle disintegrates, and emanates as before a form of subtile matter charged with the taste-potential (स्वास्वा), in addition to the three potentials already generated, and also with the physical potential of viscous attraction.
8. This subtile matter charged with the taste-potential and with the potential of viscous attraction condenses and collocates as before into the water-atom which manifests the actual specific energies of viscous attraction and the taste-stimulus.
9. The viscous water-atom charged with the actual specific Energy of the taste stimulus disintegrates, and emanates as before a form of subtile matter charged with the

smell-potential in addition to the four potentials already generated and also with the potential of cohesive attraction.

10. This subtile matter charged with the smell-potential and with the potential of cohesive attraction condenses and collocates as before into the earth-atom, which manifests the actual specific Energies of cohesive attraction and the smell-stimulus.

Vijñāna bhikṣu in the Yoga-Vārtika briefly summarises the Viśva Purāṇa process as follows :—

Bhūratī as radicle in conjunction with Mahat produces the sound potential, which as radicle in conjunction with Bhūratī produces A'kāśa, which as radicle in conjunction with Bhūratī produces the touch-potential, which as radicle in conjunction with Bhūratī produces Vāyu, which as radicle in conjunction with Bhūratī produces the colour-potential, which as radicle in conjunction with Bhūratī produces Tejas and so on.

In this brief summary he does not bring out the force of विकृत्योपः (the disintegrating process), and the distinction between the genesis of subtile and gross matter (Tanmātra and Bhūta).

अथा प्रथमेन महान्, महता स तयारहतः ।

भूतादिस्तु विकृत्योपः स गे तन्मात्रिकं मतः ।

शब्दः शब्दतन्मात्रात् आकारः शब्दतन्मात्रम् ।

शब्दमात्रं तदाकारं भूतादिः स सप्ततथोत् ।

आकाराद्भूतं विवृत्त्यर्थः सप्ततथा सप्ततथम् ।

वस्तुनाम् अमरम् वायुः तस्य सप्ततथो गुणा सप्तः । (विश्वपुराण)

11. A famous passage in *Parāśara* takes another view of the genesis and structure of the *Tanmātras* and the *Bhūta-Paramāṇus*. *Krishna-pāda*, in the *śaṅkha-saṁhitā*, represents the scheme as follows :—

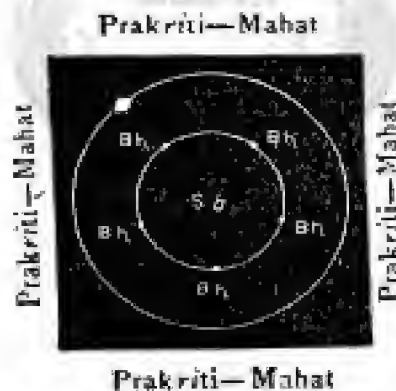
The *Tanmātras* originate from one another in one linear series, and each *Bhūta* originates in a separate line from its own *Tanmātra*.—

भूतादि (Bhūtādi)

शब्दतन्मात्रम्	Sound-Tanmātra—as a radicle or centre surrounded or encircled by Bhūtādi generates A'kāśa.
स्पर्शतन्मात्रम्	Touch-Tanmātra—as a radicle or centre encircled by Sound-Tanmātra with A'kāśa-atom as a help generates Vāyu—
रूपतन्मात्रम्	Colour-Tanmātra—as a radicle or centre encircled by Touch-Tanmātra with Vāyu-atom as a help generates Tejas—
रसतन्मात्रम्	Taste-Tanmātra—as a radicle or centre encircled by Colour-Tanmātra with Tejas-atom as a help generates Ap—
गन्धतन्मात्रम्	Smell Tanmātra—as a radicle or centre encircled by Taste-Tanmātra with Ap-atom as a help generates Prithivī.

The genesis of a Bhūta-Paramāṇu (atom) from the subtle matter of a Tanmātra is not here so simple as in the view of the Viṣṇu Purāṇa. The latter speaks of condensation and collocation, but in the passage under reference a Tanmātra is supposed to act as a radicle, as the centre of a system, surrounded or encircled by Tanmātras of the immediately higher order in the medium of its own Bhūta.

Thus an atom of A'kāśa has the following structure :—



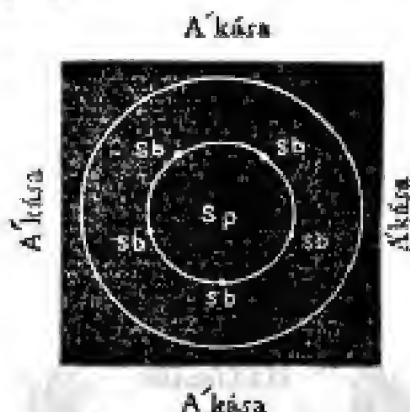
An atom of A'kāśa

Sb = Śabda-Tanmātra (vibration-potential)

Bh = (Bhūtaḍi)

An atom of Vāyu is constituted as follows :—

This takes place within the surrounding medium of A'kāśa.

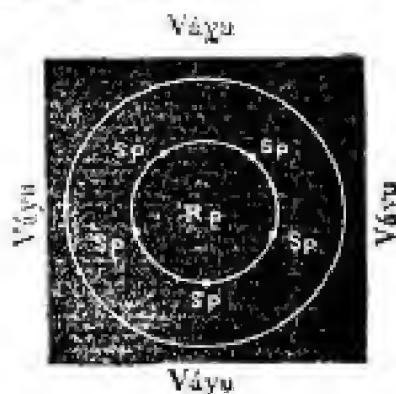


An atom of Vāyu

Sp = Sparsa-Tanmātra (impact-potential)

Sb = S'abda-Tanmātra (vibration-potential)

An atom of Tejas—heat-and-light corpuscle—
has the following structure :—



An atom of Tejas

Rp = Rūpa-Tanmātra (light-potential)

Sp = Sparsa-Tanmātra (impact-potential)

and so on.

A Chemist will be disposed to push his chemical processes into the region of subtle matter. He may translate *आवरण* as a menstruum, and *सहायक* as a catalytic agent. In this case, an atom of Vāyu will be considered as generated from the impact-Tanmātra as a radicle, in the menstruum of vibration-Tanmātra, with *Ākāśa*-atoms as a catalytic agent.

अथायं क्रमः—भूतादौः शब्दतन्मात्रं जायते, शब्दतन्मात्रं सूत्रादितारपीति, तत आकाशं जायते, ततः अस्मात् शब्दतन्मात्रात् स्पर्शतन्मात्रं जायते, स्पर्शतन्मात्रं शब्दतन्मात्रसाहचर्येति, एवं शब्दतन्मात्राहारात् आकाशसहायकात् शब्दतन्मात्रात् वायुर्जायते, ततः अस्मात् स्पर्शतन्मात्रात् रूपतन्मात्रं जायते रूपतन्मात्रं स्पर्शतन्मात्रसाहचर्येति, एवं स्पर्शतन्मात्राहारात् वायुसहायकात् रूपतन्मात्रात् तेजो जायते—and so on. अयं क्रमः तत्त्वव्यवस्थिते (वर्णिकवचने) कथमादौतः। अथर्वमुनि, तत्त्वप्रथमो (वर्णिकवचने).

A slight variation of the above view is ascribed to a certain school of Vedāntists in the *तत्त्वनिश्चय*.

The scheme may be represented as follows :—

A *Blūta*-atom is evolved by integration (condensation and collocation, *सुहायकाद्य*) from the corresponding Tanmātra (subtle matter). This is the same view as that of the *Vishnu purāṇa*.

The Tanmātras again evolve from one another in a lineal series as in Parāśara's view. But the process of this generation is somewhat more complex. A Tanmātra first disintegrates and emanates in a surrounding medium (a menstruum) of the Tanmātra just preceding it in the order of genesis and with the help of its own Sthūla Bhūta as a sort of catalytic, generates the Tanmātra next in order : e.g., the infra-atomic impact particles (सर्वात्मका) disintegrate or emanate, in a surrounding 'atmosphere' of the vibratory subtle matter (सूक्ष्मात्मका) and then with the help of their own atomic integration Vāyu, gas, generate the Tanmātra next in order, the subtle matter of radiant light-and-heat (तेजः).

III. Patañjali's view, as expounded in the व्यासभाष्य and योगशास्त्रिक is as follows :—

(a) The order of genesis of various forms of subtle matter (potentials) :—

- (1) Bhūtādi, the rudiment-matter, original Mass, acted on by Rajas, Energy, produces the sound-potential (vibration-potential) अनादिकाभाक् अद्वयराभा सकाक्षरमने राजसहकारः सहकारी भवति ।

- (2) This subtle vibration-potential, as a radi-

(Bhūtādi) condensing and collocating, and acted on by Rajas, generates the subtle touch-potential (impact-potential) which is impingent as well as vibratory (oscillating).

- (3) This subtle impact-potential again, as a radicle, with accretion of rudiment-matter (Bhūtādi) condensing and collocating, and acted on by Rajas, generates the subtle light-and-heat potential (स्पर्शशक्ति) which radiates light-and-heat, in addition to being impingent and vibratory.
- (4) Next, the light-and-heat potential, as a radicle, with accretion of rudiment-matter, (Bhūtādi) condensing and collocating as before, generates the subtle taste-potential, which is charged with the potential of the taste-energy, and of viscous attraction, in addition to being vibratory, impingent and radiant.
- (5) Lastly, the subtle taste potential as a radicle, with accretion of rudiment-matter as before, condensing and collocating, generates the subtle smell-potential, which is charged with the potential of the smell-energy, and also of cohesive attraction, in addition to being vibratory, impingent and radiant.

The order of genesis of the Bhūta Paramāṇus (forms of atomic matter).

The five classes of atoms are generated as follows :—

- (1) The sound-potential, subtle matter, with accretion of rudiment-matter (Bhūṭādi) generates the A'kāśa-atom.
- (2) The touch-potentials combine with the vibratory particles (sound-potential) to generate the Vāyu-atom.
- (3) The light-and-heat potentials combine with touch-potentials and sound-potentials (i.e. with impact particles and vibratory particles) to produce the Tejas-atom.
- (4) The taste-potentials combine with light-and-heat potentials, touch-potentials and sound-potentials (i.e. with radiant, impingent and vibratory particles) to generate the Ap-atom and
- (5) The smell-potentials combine with the preceding potentials (i.e. with particles of taste-energy and with radiant, impingent and vibratory particles) to generate the earth-atom.

The A'kāśa-atom possesses penetrability, the Vāyu-atom impact or mechanical pressure, the Tejas-atom, radiant heat-and-light, the Ap-atom, viscous attraction, and the Earth-atom, cohesive attraction.

Vijñāna-bhikṣu in one passage gives the following scheme of the genesis of the Bhūtas :—

A radicle of sound-potential with rudiment-matter gives A'kāśa-atom (Bhūtādi), a radicle of touch-potential with A'kāśa-atom gives Vāyu-atom, a radicle of light-and-heat potential with Vāyu-atom gives Tejas-atom, a radicle of tastepotential with Tejas-atom gives Ap-atom, and a radicle of smell-potentials with Ap-atom gives Earth atom. On this view, an atom

of A'kāśa = Bh(Sb)

of Vāyu = { Bh(Sb) } (Sp)

of Tejas = { Bh(Sb) } { (Sp) } Rp

where Bh = भूतदि, Sb = स्पर्शकदि, Sp = स्पर्शकदि, Rp = रसकदि, and so on.

Bhūtas and Paramāṇus—Cosmo-genesis and its successive stages.

The 'five Bhūtas' stand for a classification of substances on the basis of their generic properties resulting, as the Sāṅkhyas hold, from the structural type of their constituent atoms—a classification more physical than chemical, or properly speaking chemico-physical, unlike the purely chemical classification of the so-called elements of modern chemistry. A Paramāṇu, again, is a type of atoms corresponding to each Bhūta class, and indeed one and the same kind of Paramāṇu may comprehend atoms

of different masses, if only these should agree in their structural type.

Cosmo-genesis—a bird's eye view :—Out of the all-pervasive rudiment-matter (Bhūtādi) appeared Ākāśa (ether), first as a Tanmātra (subtle matter) charged with the potential energy of sound (vibration-potential), and then as an atomic integration of a mono-Tanmātric structure (the Ākāśa-atom—*आकाशाणु*) also ubiquitous and all-enveloping. In the next stage we find a new kind of Tanmātras, systems of the infra-atomic vibratory particles, so arranged as to manifest a new form of energy, that of impact or mechanical pressure and these Tanmātras (*आकाशाणु*) combining with the vibration-potentials (Ākāśa Tanmātra) produced a new kind of atom, the di-Tanmātric Vāyu-atom, which by aggregation formed a gaseous envelope composed of impinging (driving) vibratory particles (Vāyu). Next appeared the third class of Tanmātras, infra-atomic systems of the impinging vibratory particles, which by their collocation developed a new form of Energy—the energy of radiant heat-and-light. These Tanmātras (*आकाशाणु*) combining with the potentials (Tanmātras) of vibration and impact, produced a new kind of atom—the tri-Tanmātric Tejās-atom, the light-and-heat corpuscle, which by aggregation enveloped the gaseous world in huge flames. In the next stage we have the fourth class of

Tanmātras, new and complex infra-atomic systems of the radiant impinging vibratory particles, which evolved the energy of viscous attraction as well as the potential Energy concerned in the taste-stimulus. These Tanmātras (तन्मात्राणि) combining with the three previous ones, gave rise to another class of atoms, the tetra-Tanmātric Ap-atom, and the flaming gases were thus precipitated into cosmic masses of viscous fluid matters (Ap). Finally appeared the fifth class of Tanmātras infra-atomic systems of the viscous radiant impinging vibratory particles which developed new forms of Energy—the Energy of cohesive attraction, as well as the potential energy concerned in the stimulus of smell. These Tanmātras (तन्मात्राणि) uniting with the other four kinds or infra-atomic subtile particles, formed another class of atoms, the penta-Tanmātric Earth-atom. Thus the viscous fluid matters were condensed and transformed into the Earth-Bhūta, comprising the majority of the so-called elements of chemistry.

The Purānas, in their own fanciful way, conceive that, in the course of cosmic evolution, each succeeding Bhūta appeared within an outer envelope of its immediate predecessor, with a total mass (or volume $\frac{1}{10}$) a tenth less than that of the latter.

विद्यन् तदाद्येकद्वयतरी वायुः प्रकल्पितः ।

चिकरीत् वज्रिमण्डलेन सङ्गीतं व्युत्पन्नम् ॥

तदाकाशवर्षेणैवां व्युत्पन्नं विचारया ।

वायोर्द्वयं शतौ व्युत्पन्नौ वज्रिवायौ प्रकल्पितः ॥

पुराणीनं तारतम्यं दशविंशत्युत्पन्नम् ॥

(पञ्चदशो-सूत्रविवेक, slokas 72, 81 and 82)

Examples of the different Bhūtas :—

1. A'kāśa :—This is ubiquitous.
2. Vāyu :—Various substances composed of di-Tanmātric atoms,—kinds of Vāyu—must have been formed in the gaseous envelope in the second stage of cosmic evolution, out of the proto-atoms of A'kāśa. But they have either suffered a fresh transformation into substances of a more complex atomic structure, or have dissipated into the mono-Tanmātric A'kāśa, out of which they took their rise. The one familiar example now surviving is atmospheric air. Water-vapour (वाष्प) is but water (Ap), and smoke, fumes, etc. but earth-particles in gaseous diffusion.
3. Tejas .—Various classes of Tejas corpuscles,—substances with tri-Tanmātric atomic structure, i.e. two grades subtler

than the ordinary elements of chemistry (which are of a penta-Tanmātric structure),—are even now known. (तेजो भौमादि-
भेदेन बहुविधं । भौमं दिव्यं चोदके चकारजं—
वरवरमुनि,—तत्त्वप्रयोगः ।)

First, there is fire, or the light-and-heat emitted by the burning log of wood or lamp (चरिः—दीपः—
भौमं तेजः). Now it is important to note that the flame of a burning log of wood (वृक्ष) or an oil-
lamp is not pure Tejas, a pure mass of light-and-
heat corpuscles. There is chemical union with
Earth-particles (particles of the hard penta-Tan-
mātric substance) acted on by Energy; and then
the Tejas corpuscles, light-and-heat particles which
are latent (absorbed) therein, come forth as
flame (पार्थिवीवृक्षयोः सद्गुणत्वात् तेजसः चरिर्भवति—
विज्ञानमिश्रु—प्रवचनभाष्य. Sūtra 110, Chap. V).
Then there is the light of the sun and the stars
(दिव्यं सौरं चादित्यादि) which are flaming masses of
molten viscous matters (तप्तमादित्यम् तेजः दिव्यं तप्त
सूर्यादि,—तत्त्वप्रयोगः, चरितुल्लङ्घन) or of molten
earthy matters सूर्यादीनि सूर्यादि तेजादि पार्थिवद्रव्य-
सङ्गेनैव चरस्त्रितानि,—विज्ञानमिश्रु, प्रवचनभाष्य. Sūtra 13,
Chap. III). There is also the lightning, which
liberates a kind of Tejas latent in the aqueous
particles and vapours, under the action of

Energy, in the same way as an ordinary fire liberates the Tejas latent in the wood or other fuel. Next there are the stores of animal heat derived from the break-up of the nutritive material (चौदशै). Lastly there comes the peculiar form of the Tejas Energy (radiant Energy) stored up in the metalliferous ores and igneous rocks which have been formed in the subterranean heat. Here Earthy matters are mixed up, but the radiant Energy predominates in the composition of the metals (तेजसाभिपद्येन तेजसादिना मृत्तमदीना—विद्या-निघ्न, प्रवचनसाम्प्र, Sūtra 19, Chap. III). Aniruddha, a late Sāṅkhya commentator, notes in reference to 'igneous bodies' that the greater part of their mass is derived from the Earth-Bhūta, though the Tejas particles determine the peculiar chemical combination, which produces them; and this must also be his view of the composition of the metals. तत्र अपि (तेजसि प्रदीपे अपि) बहुतरणार्थिवावयववद्व्यक्तम्, अत्यन्ते आनुपमयोगात् । (अनिरुद्धादि—Sūtra 112, Chap. V.)

4. Ap. This viscous fluid of a tetra-Tasmātric structure has but one pure example, viz., water, though the various organic acids, the juices of fruits and the saps of plants, are supposed to be transformations of watery radicles combined with different kinds of earthy accretions.

5. Lastly the Earth-Bhūta, the hard full-formed matter, with its penta-Tanmātric atoms, comprises by far the majority of the so-called chemical elements.

The question is,—how does one and the same Bhūta, of the same formal structure, comprise different kinds of elements, with different atomic masses, and different characteristic properties? And the answer is not far to seek. The properties of a thing are only the energies that are manifested in the particular collocations of the three Gunas,—Mass, Energy and Essence; and a tri-Tanmātric, or a penta-Tanmātric atom, i. e. an atom composed of three or of five kinds of Tanmātras may differ from another of the same class, in respect of the number of constituent Tanmātras of any particular kind, as also of their collocation or grouping, and therefore in mass as well as in generic and specific characters.

The Sāṅkhya-Pātañjala conceives the properties (or energies) of substances to result from the grouping or the quanta of the Tanmātras, or the Gunas themselves, and hence any radical differences in substances of the same Bhūta class must characterise their atoms, though in an infra-sensible form. In the Nyāya-Vaiśeṣika, on the other hand, the atoms of the same Bhūta class are alike in themselves, homogeneous; and the

variety of substances comprehended under the same Bhūta, is ascribed merely to the different arrangements or groupings of the atoms (अणु) and not of their components, for components they have none.

As a typical and familiar instance of the variety of characteristic properties (or energies) that may result from variations in accompaniment or grouping, the Sāṅkhya-Pātañjala points to the various kinds of fruit acids and juices, all originating from one and the same Bhūta (water) with different accretions of earthy matters (सृजकारः). In the same way, though we speak of only five classes of Tanmātras and atoms, the infinite variety of the world results from the infinitely varied collocations of the three original Gūṇas, which underlie Tanmātra and atom alike (सत्त्वगुणकर्मणो अपकर्षकात्तावतः संघातः परमाणुरिति—व्यासवार्तिक, एतदीयकर, reporting the Sāṅkhya view : अनुसन्धिहानवतः संघातः परमाणुरिति—व्यासभाष्य, Sūtra 44, Pada III.—परमाणुः सामान्यविशेषाभ्यामनुसन्धिहानयवभेदानुगतः समुदायः—व्यासभाष्य, Sūtra 44, Pada IV.—द्यौमतावाच्यता धर्मिणः शक्तिरेव धर्मः (ibid., Sūtra 14, Pada III.) की धर्मेषु अनुपाती सामान्यविशेषाका सोऽन्वयी धर्मो (ibid., Sūtra 14, Pada III).

सादितम्—कथं एकद्वयाद्यो युक्तयोऽनेकद्वया प्रकृतिः—
एकत आदय परिधामतः सल्लिखन्तु । यथा वादिदिमुक्तं सदर्थं
एकरसं अपि तत्तद्विकाराण् आसाद्य नारिजेक-तासी-विल-

चिरविल-तित्कुसलक-कपित्थकलरसतया परिचामान् मधुराश्लक्ष्म-
निककटुकपायतया विचल्यते, एवमेकैकगुणसम्भवात् प्रधानं गुणम् चाश्लि-
ष्यमधानशुभाः परिचामभेदान् प्रवर्धयन्ति । तदिदमुक्तं प्रतिपत्तिगुणायय-
विशेषान्, एकैकगुणादयैव यी विशिष्टकष्यान् ज्ञेयैः ।

(वाचस्पति—कौमुदी—On Kārikā 16.)

If we take a unit of rudiment-matter (Bhūtādi) for the unit of mass (cf. the mass of an electron with a charge of motion etc.), and represent the first Tanmātra by t_1 such units, and if further, t_2, t_3, t_4, t_5 units of mass (Bhūtādi) be successively added at each accretion to form a fresh Tanmātra, then the second, third, fourth and fifth Tanmātras will respectively contain $t_1 + t_2, t_1 + t_2 + t_3, t_1 + t_2 + t_3 + t_4$, and $t_1 + t_2 + t_3 + t_4 + t_5$ units of mass.

Also the Vāyu atom (bi-Tanmātric system) will contain $t_1 + (t_1 + t_2)$, i.e. $2t_1 + t_2$ units of mass; the Tejas-atom (tri-Tanmātric system) will contain $t_1 + (t_1 + t_2) + (t_1 + t_2 + t_3)$ i.e. $3t_1 + 2t_2 + t_3$ units; the Ap-atom (tetra-Tanmātric system) $t_1 + (t_1 + t_2) + (t_1 + t_2 + t_3) + (t_1 + t_2 + t_3 + t_4)$, i.e. $4t_1 + 3t_2 + 2t_3 + t_4$ units; and the Earth-atom (penta-Tanmātric system), $t_1 + (t_1 + t_2) + \dots + (t_1 + t_2 + t_3 + t_4 + t_5)$, i.e. $5t_1 + 4t_2 + 3t_3 + 2t_4 + t_5$ units.

If t units of mass be added to the first Tanmātra to form the atom of A'kāśa, the latter will contain $t_1 + t$ units of mass.

In other words the numbers representing the mass-units (Tamas) in the different classes of atoms (gross matter) will form an ascending series, viz. $t_1 + t$, $2t_1 + t_2$, $3t_1 + 2t_2 + t_3$, $4t_1 + 3t_2 + 2t_3 + t_4$, and $5t_1 + 4t_2 + 3t_3 + 2t_4 + t_5$.

Now if a follower of the Sāṅkhya-Pātañjali were asked to account for differences among Paramānus of the same Bhūta class, he would perhaps suppose t_1 to vary from α_1 to β_1 , t_2 from α_2 to β_2 , t_3 from α_3 to β_3 , t_4 from α_4 to β_4 and t_5 from α_5 to β_5 .

Therefore the mass-units contained in the Vāyu-atoms of the different possible Vāyu substances would be represented by $2\alpha_1 + t$, $2\alpha_1 + 1 + t$, $2\alpha_1 + 2 + t$, $2\beta_1 + t$, in A. P. with unity as common difference, there being $2(\beta_1 - \alpha_1) + 1$ possible Vāyu substances.

The mass-units contained in the Tejas-atoms of the different possible Tejas substances would be represented by the series, $3\alpha_2 + 2\alpha_1 + \alpha_3$, $3\alpha_1 + 2\alpha_2 + \alpha_3 + 1$, $3\beta_1 + 2\beta_2 + \beta_3$, increasing in A. P. by unity as common difference, then being $3(\beta_1 - \alpha_1) + 2(\beta_2 - \alpha_2) + (\beta_3 - \alpha_3) + 1$, Tejas substances possible.

The mass-units contained in the Ap-atoms of the different possible Ap-substances would form the series $4\alpha_1 + 3\alpha_2 + 2\alpha_3 + \alpha_4$, $4\alpha_1 + 3\alpha_2 + 2\alpha_3 + \alpha_4 + 1$, $4\beta_1 + 3\beta_2 + 2\beta_3 + \beta_4$, there being $4(\beta_1 - \alpha_1) + 3(\beta_2 - \alpha_2) + 2(\beta_3 - \alpha_3) + (\beta_4 - \alpha_4) + 1$ Ap-substances possible.

The mass units contained in the Earth-atoms of the different possible Earth-substances would form the series in A. P., $5x_1 + 4x_2 + 3x_3 + 2x_4 + x_5$, $5x_1 + 4x_2 + 3x_3 + 2x_4 + x_5 + 1, \dots, 5\beta_1 + 4\beta_2 + 3\beta_3 + 2\beta_4 + \beta_5$, there being $5(\beta_1 - x_1) + 4(\beta_2 - x_2) + 3(\beta_3 - x_3) + 2(\beta_4 - x_4) + (\beta_5 - x_5) + 1$ Earth-substances possible.

Size (वर्माण).—As to size or volume, the Sāṅkhya accepts only two kinds,—the infinitesimal, which is also without parts (अणु—निरत्यग) and the non-infinitesimal, which consists of parts (सङ्ख्य—मात्रक). The latter varies from the excessively small (the so-called *Arus*, *Tanmatras* and *Paramāṇus*) to the indefinitely great (परमसङ्ख्य—विश्व.—e.g.—A'kāśa).

The *Gunas* alone are infinitesimal, with the exception of those ubiquitous ones that evolve into A'kāśa-atoms and Mind-stuff (आकाशम् and मनः-वस्तु):—all the rest of the evolved products (whether subtle or gross matter) are non-infinitesimal.

Vijñānabhikṣu notes that all the *Gunas* (Reals) cannot be ubiquitous. If this were the case, that disturbance of equilibrium, that unequal aggregation with unequal stress and strain, with which cosmic evolution begins, would be impossible. The *Gunas*, which give rise to A'kāśa and Mind-stuff, must be held to be ubiquitous, and this will suffice for the ubiquity of *Prakṛiti*,

(न च अस्मद्वर्गे गुणास्तथैकैः विभुलमेवावगमते इति याच्यम् ।
 अन्तःकारणाकारादेतुगुणाणां विभुलमेव तदुपपत्तेः । सर्वगुणाणां विभुल-
 इति आद्यपरिणामहेतुर्वाचस्पतिमीमांसकाद्यसंभवान् (श्रीवार्हस्पतिः, Sūtra 51,
 Pada III.)

Chemical analysis and Synthesis—Elements and Compounds.

What then is the equivalent in the Sāṅkhya-Pātañjala of the distinction between a chemical element and a chemical compound, or is there none? Did or did not this elaborate physical analysis and classification of things lead on to a classification based on chemical analysis and chemical synthesis? These are questions of singular interest, the answer to which will disclose some new points of view from which the ancient Hindu thinkers approached the problems of chemical physics and physical chemistry.

Aggregates (संज्ञाः) may, in regard to their structure, be divided into two classes, (1) those of which the parts are in intimate union and fusion, being lost in the whole (अयुतसिद्धावयवाः संज्ञाः) ; and (2) mechanical aggregates, or collocations of distinct and independent parts (युतसिद्धावयवाः संज्ञाः).

A substance is an aggregate of the former kind, and may be divided into two classes, (1) the Bhūtas and their 'isomeric' modifications सूत, सूतमेद and सूतविचार) ; and (2) chemical compounds (सिद्धिरद्वय,

रसयुक्तं). Chemical compounds again may be subdivided into two classes, (1) those composed of atoms of the same Bhūta class, i.e. of different isomeric modifications of the same Bhūta, and (2) those composed of atoms of different Bhūta classes. In the first case, there is contact between 'isomeric' atoms (सजातीय-संयोग), in the second case, between heterogeneous or 'polymeric' ? atoms (विजातीय-संयोग). The first contact leads to intimate union (सङ्गः—सङ्गणः सः संयोगविशेषः तद्वैय द्रव्याणां विकारो भवति—विज्ञानमिश्र द्रव्यसमाय); the isomeric atoms by a peculiar liberation of Energy (सजातीयोपद्रव्य—the action of similars on similars) are attracted towards one another, and being riveted as it were, form the so-called material cause (उपादान कारण) of the compound product. The second kind of contact (that between unlike or 'polymeric' ? atoms of heterogeneous Bhūtas) begins with a liberation of Energy (उपद्रव्य), which breaks up each of the Bhūtas, and taking particles (or atoms) of one as nuclei or radicles groups particles of the rest round these radicles in a comparatively free or unattached condition. In this case, one Bhūta, that which serves to furnish the radicles, not necessarily that which is numerically or quantitatively predominant, gets the name of material cause (उपादानकारण), and the others, which by their collocation cause the liberation of Energy (उपद्रव्य, उपद्रव्य or विद्रव्य),

are called efficient causes (निमित्त कारण)—एवमेकैक-
 गुणसम्भवात् इषान् गुणजातस्य चरधानगुणाः परिणामभेदान्
 प्रवर्तयन्ति—वाचस्पति, कौस्तुभे on Kārikā 16. The illus-
 tration given (viz. the Rasas as modifications of
 Ap, water, with Earth-accretions) show that this
 process applies not only to the Gunas, but also to
 the Bhūtas. यथा वाकादिकरणं यत्किञ्च पतितं नानाद्वयात्
 संज्ञेयान् भिद्यते—(श्रीकणाद on Kārikā 17),—तत्र अपि (तेजसे
 यदीदं अपि) बहुतरपार्थिवानववायव्यभात् एतन्ने च अनुपमीयान् (अनिरुद्ध
 on Sūtra 112, Chap. V), जातिसादृश्यं यथाकमदीयत्वात्
 कामदीयमवधाने यनेकैरपि इन्द्रियैः एकदा एकवस्तुत्वात्तदने वाचकं नास्ति
 (विज्ञानसिद्ध—प्रवचनभाष्य).

Aniruddha goes so far as to hold that both
 'isomeric' and 'polymeric' (or 'heterogenic') com-
 binations are real cases of constitutive contact,
 (आरम्भकसंयोग, e.g. लौहिकवायीर्द्वारम्भकत्वम्—अनिरुद्ध on Sūtra
 113, Chap. V.) But in the later Sāṅkhya-Pātañjala
 the current teaching denied this—वज्रनामुपादानाद्योपादानं
 (Sūtra 102, Chap. V), when विज्ञानसिद्ध notes—वज्रनां
 निवृत्तानीयानां ओपादानत्वं न दृष्टमिति सज्जानीयमेवोपादानम्। इतरच्च
 मूलवस्तुद्वयमुपदृष्टव्यम्।

But besides these transformations of substance
 (इषान्तर-परिणाम) by 'isomeric' or 'heterogenic'
 process, ceaseless changes go on in the characters,
 the modality, and the states of substances—changes

which are due to the unequal distribution of force (or of stress and strain,—pressure) among the Gunas, which are in themselves constant. (धर्म-लक्षणावस्थापरिचयात्: न द्रव्यान्तरतः,—एषा एका रीत्या जगत्प्रसूतिं जगत् दहस्यति इय. एकैकैकस्याने, सदा चैकानेऽपि स्त्री माता चोच्यते दुहितौ च स्वमा चरति,—गुणविभक्त्येऽपि गुणानां विभर्तवैविचर्यात्—व्यासभाष्य, Sūtra 13, Pada III.)

“Even as the same figure ‘1’ stands for a hundred in the place of hundred, for ten in the place of ten, and for a unit in the place of unit.”*

* This conclusively proves that the decimal notation was familiar to the Hindus when the Vyāsa-Bhāṣya was written, i.e. centuries before the first appearance of the notation in the writings of the Arabs or the Greco-Syrian intermediaries. Vāchaspati, who comments on the Vyāsa-Bhāṣya, composed his Nyāya-Sūtrī-Nibandha in सप्तमदशसहस्ररे i.e. Samvat 898 or 842 A. D. This cannot be S’aka 898, for apart from the decisive use of सत्सर, which by this time had come to signify the Samvat era, Vāchaspati’s commentator Udayana, wrote the Lakṣanāvalī in S’aka 906—

तर्काम्बराद्व्यभिचारीनेषु त्रकालतः ।

वर्षेभ्यश्चक्रे कुवीर्य लक्षणावलीम् ॥

and Udayana, who wrote the Parīśuddhi on the Tātparyya-tīkā of Vāchaspati, could not have been a contemporary of the latter, as will also appear from the invocation to Sarasvatī in the opening lines of the Parīśuddhi. Vāchaspati then preceded Udayana by 142 years, and must have been himself preceded by the author of the Vyāsa-Bhāṣya by a

Now the question is—in these mixed substances does the fusion take place by Paramāṇus or by larger masses (or lumps)? Now a Paramāṇu is defined to be the smallest portion of any substance which exhibits the characteristic qualities of that substance,—in other words, it stands for the smallest homogeneous portion of any substance. It is not without parts and therefore not indivisible. It is subject to disintegration. In a Bhūta or its isomeric modification, the Paramāṇu, the smallest homogeneous component particle, is unmixed, and therefore corresponds to the atom of modern chemistry. In a mixed substance (मिश्रद्रव्य, *miśra-dṛvya*) whether it is an 'isomeric' or a 'polymeric' compound, the qualities are due to the mixture, and therefore its Paramāṇu, the smallest homogeneous particle possessing its characteristic qualities, must result from the mixture of the Paramāṇus (in smaller or larger numbers as the case may be) of the component substances. The Para-

longer interval still, for Vāchaspati ascribes the Bhāṣya to Veda-Vyāsa himself (वेदव्यासीन आदिनि भाष्ये व्यासो विष्णुः १). The internal evidence also points to the conclusion that the Bhāṣya cannot have been composed later than the sixth century,—cf. the quotations from *Pañchasikha*, *Vārisaganya*, and the *Shashtri-Tantra-Sūtra*, without a single reference to *Īvara-Krishna*—which is decisive. I may add that I remember to have come across passages of a similar import in Buddhist and other writings of a still earlier date.

mānu of a mixed substance therefore corresponds to what we now call molecule. (अपकर्षपर्यन्तं द्रव्यं परमाणुरिति—व्यासभाष्यः । लौकिके हि प्रविभज्यमानस्य युक्तिरवयवैरेव व्यक्त-
 तारत्वं व्यतिष्ठते यः अपकर्षदर्थेन परमाणुः—वाचस्पति—तत्त्वदीयारहो—
 Sūtra 52, Pada III.—आणुमिवता न निर्भासतः । प्रविषोपरमाणुः
 जलपरमाणुरित्यादिव्यवहारस्तु प्रविज्यादीनामवकर्षकात्तामिसाधैर्येव । विज्ञान-
 मित्त्वं—प्रवचनभाष्य, Sūtra 88, Chap. V.)—That the
 Paramānus form molecules (आणुः) in forming
 substances, is acknowledged by the Sāṅkhyas as will
 appear from Gaudapāda,—तथा अनोक्तप्रायश्च आणुकमदमुषाः ।
 (गौडपाद, on Kūṛikā 12). Even the Vaiśeṣikas, with
 their prejudice against 'polymeric' or 'heterogenic'
 combination, acknowledge that in 'polymeric' com-
 pounds the different Bhūta-substances unite by their
 Paramānus (or atoms), though they rigidly insist
 that in such cases only one atom should be regarded
 as the 'radicle' (उपादान or दन्तारमककारण) and the
 others as co-efficient causes (निमित्तकारण—उपहृत्कारण),
 e. g. पञ्चकपाद—एवं समुत्पद्येत् अतर्ह्य मद्भासतेत् सविस्तराभिधानमा-
 वात् तैजसीभ्योऽप्यभ्यः पार्थिवपरमाणुसहितेभ्यो मद्ददत्तमुत्पद्यते (पञ्चक-
 पादभाष्य—where S'ridhara notes पार्थिवं अवयवमा उपहृत्कारणं
 and Udayana तैजसानां परमाणूनां पार्थिवाणुसहितेन अतर्ह्य
 द्दिरपहृत्यते' (श्रुतिं) ।

It is only in the mediæval Sāṅkhya-Pāteñjala that under the influence of the Nyāya-Vaiśeṣika doctrine a radical difference was conceived to exist between the structure (or constitution) of a molecule composed of 'isomeric' atoms, and that of one composed of heterogeneous (or 'polymeric') atoms. In the former case, there was believed to take place intimate union (सङ्ग), in the latter case, only a grouping of comparatively free or loosely attached atoms round a radicle atom (सङ्गम), with liberation of Energy (उपपन्न—उत्पन्न—or विद्यु) and the setting up of unequal stress and strain (गुणवैकल्यविमर्श—ईद्वयकण). At the same time, it was of course admitted that this distinction does not apply to the forms of subtle matter (Tanmātra—सूक्ष्म) which could unite in intimate fusion, whether homogeneous or heterogeneous. For example, the subtle body (सूक्ष्मशरीर) which is supposed to be the seat or vehicle of the conscious principle is acknowledged by Vijñāna-bhikṣu to be penta-Bhautic (पञ्चभूतात्मक); in other words, all the five Tanmātras serve as material causes, though the gross body (the animal organism) is stated to be only a 'polymeric' compound with the Earth-Bhūta as radicle or base. अधिष्ठातृशरीरं च सूक्ष्मं पञ्चभूतात्मकं इत्यस्ति । तन्मात्राचार्येण सूक्ष्मपञ्चकं लिङ्गाभिधानं शरीरम् (प्रवरणभाष्य—Sūtras

11 and 12, Chap. III.—सूत्रप्रदीपं पार्थिवमेव जगामि च
मृगानि उपरुन्मकामि (*ibid.* Sūtra 19, Chap. III.)

But in the original Sāṅkhya-Pātañjala it appears that the production of a new substance by mixture of unlike Bhūtas (विजातीयसंयोग) was conceded as freely as in the Vedānta, and was conceived as nowise differing from the formation of a compound of atoms of the same Bhūta class. The Sāṅkhya analysis of all change into transformations of Energy due to collocations of unchanging Gunas, in other words, the prevailing chemico-physical (or physical) point of view, naturally recognises no distinction between collocations of 'isomeric' and those of heterogeneous (or 'polymeric') atoms. At bottom they are all collocations of the Gunas. Even Vijñāna-bhikṣu who, as one of the latest exponents of the Sāṅkhya-Pātañjala, has been most affected by the Vaiśeṣhika prejudice against 'polymeric' combination (विजातीयसंयोग) urges that the qualities of a compound substance are not necessarily the result of similar qualities in the component elements. (सजातीय-कारणगुणसंयोग-कार्यगुणारम्भकता इति तु तेषां (तार्किकानां) अपि न विदमः ।) Elsewhere he explains that far from the vital activity being independent it is originated and maintained by the combined operation or fusion of the different sensory and motor reflexes of the living

organism, and notes that the united operation of mixed (or miscellaneous) causes, where there is a fit collocation of matter, offers no difficulty to a follower of the Sāṅkhya-Pātañjala :—(जातिसाङ्ग्यस्य अस्माकमदो-
पत्ताय, सामयोरसम्बन्धाने सति एतेकैरेव इन्द्रिये एकदा एकवस्तु-
साधने नाशकं नास्ति—प्रवचनभाष्य, Sūtra 32, Chap. II). In the middle of the ninth century, we find Vāchaspati instancing some 'heterogenic' or 'polymeric' compositions as typical examples of evolutionary change (परिवर्तन) and unhesitatingly accepting the substantive character of the products. In the Kaṇmudī he describes the various acids and juices of fruits as modifications of the same original water in the presence of different kinds of earthy accretions. The process is peculiar. The water-particle (or atom) serves as a radicle or centre of a system, and the different kinds of the Earth-Bhūta centering round this as a nucleus become the seat of forces, which bring in the development of new energies (and new qualities, e.g. tastes) in the water. यथा वारिद्विमुक्तमुदकं
एकसमसि द्रवद्रुतविकारः न आसद्य कारिकेन-तानी-विल-कटिआदि-
रसतया परिवर्तमानं सधुवासकवर्तककटुकपादतया विकस्यते । इति
एकैकद्रुतसम्बन्धान् प्रधानद्रुतम् आदिद्य अप्रमानद्रुताः परिवर्तनमेदान्
प्रवर्तयन्ति । (कीमुदी on Kārikā 16). Vāchaspati also points out that different substances may be transformed into one and the same substance (e. g.

the production of salt by the cow, the horse, the buffalo and the elephant, thrown into the salt factory of Sambara in Rajputana or of the flame of a candle by the combination of wick, oil and fire. (परिष्कारकत्वं महनामपि वक्तुं; परिष्कारः दहः। तद्वत्तया तदाद्वय-सङ्घटनान्नानां वस्तुनिर्माणानां एकत्ववशात्सामासीदलक्षणम्; परिष्कारः, वर्तित्वेति तान्नानां च प्रदीप इति।—तत्त्ववैशारदी ०१ व्यासभाष्य, Pada IV. Sūtra 14.)

Earlier still, i.e., not later than the sixth century, the Vyāsa-Bhāṣya, noting that inorganic matter, vegetable substances and animal substances do not differ from one another essentially in respect of their potential energies and ultimate constituents, points out that various bi-Bhautic chemical compounds of water and earth substances, in the shape of saps, acids and juices, are found in plants in their different parts (जलभूमीः परिष्कारिकं रसादिवैश्वर्यं स्यादरेद् दहन्). In other words, bi-Bhautic compounds are here placed in the same category as 'isomeric' compounds of substances of the same Bhūta class, for here the particles of both the Bhūtas are regarded as forming the matter (material cause—अवयवानकारण) of the smallest homogeneous portions of the compound substances.

N.B.—Vāchaspati naturally interprets this to mean separate modifications of the two Bhūtas.

The view of the earlier Sāṅkhyas that atoms of different Bhūtas may chemically combine to form molecules of compound substances as much as atoms of different modes of the same Bhūta comes out clearly in Utpala's brief reference to the Sāṅkhya system in his commentary on Varahamihira's *Vrihat Samhita*. (एवः पञ्चम. [तन्मात्रेणः] पञ्चमदाभूतानि भवन्ति । तेभ्यः प्रतीतिना प्रतीयन्ति । यतः पञ्चमदाभूतमयानि प्रतीयन्ति Utpala, Chap. I, Ś'loka 7).

Chemistry in the medical schools of ancient India :—As a matter of fact, long before the fifth century, probably as early as the first century A. D., the prevailing schools of medicine and surgery which were based on the Sāṅkhya teaching with a methodology derived from the Nyāya-Vaiśeṣika doctrine (cf. Charaka, S'ārirasthāna, Chap. I, Vimānasthāna, Chap. VIII—also Susruta, S'ārirasthāna, Chap. I) had founded an elaborate theory of inorganic and organic compounds, which equally admitted iso-Bhautic and hetero-Bhautic combinations. Like the Vedantists, Charaka held that each of the gross Bhūtas (Mahābhūtas) is a peculiar ultra-chemical compound of five original subtle Bhūtas. In this sense, every substance is penta-Bhautic, but for purposes of chemical analysis and synthesis, i. e. considered with reference to the Mahābhūtas, all substances in their chemical constitution, belong to

one or other of the following classes : Mono-Bhautic, bi-Bhautic, tri-Bhautic, tetra-Bhautic, and penta-Bhautic. Compounds of different Bhūtas, again, may combine to form more complex substances, and these in their turn, higher compounds still, and so on in progressive transformation, as is more especially the case with organic substances and products.

Physical characters of the Bhūtas :—The prevailing physical characters of the different Bhūtas and their isomeric modes are enumerated as follows.

Earth-substances—Heavy, rough, hard, inert, dense, opaque, exciting the sense of smell.

Ap-substances—Liquid, viscous, cold, soft, slippery, fluid, exciting the sense of taste.

Tejas-substances—Hot, penetrative, subtle, light, dry, clear, rarefied, and luminous.

Vayu-substances—Light, cold, dry, transparent, rare-fied, impingent.

Akāśa-substances—Imponderable (or light), rarefied, elastic, capable of sound (vibrations).

(गृहस्थरक्तमिन्द्रियविषयस्य-स्युत्पत्त्यगुणवद्वृत्तानि धार्यमानि ।
द्रवमिन्द्रियमिन्द्रियविषयस्य-स्युत्पत्त्यगुणवद्वृत्तानि धार्यमानि ।
सप्तमीन्द्रिय-
स्युत्पत्त्यगुणवद्वृत्तानि धार्यमानि । सप्तमीन्द्रियविषयस्य-स्युत्पत्त्यगुणवद्वृत्तानि धार्यमानि ।)

गुणबहुलानि वायव्यानि । सद्गुणवृक्षप्रकाशसद्गुणबहुलानि वाकाशम-
काणि ।—Charaka, S'áirasthāna, Chap. 26 ; compare
Susruta, S'útrasthāna, Chap. 41).

Charaka points out that the primary qualities or specific physical characters of the five Bhūtas are tactile qualities, i. e. sensible to touch, *e. g.* hardness (or roughness) for Earth, liquidity (or yielding to pressure) for Ap, impelling or moving force (pressure) for Vāyu, heat for Tejas, and Vacuum (non-resistance, penetrability) for Ākasa.

(खरद्वयवशोऽखलं भूतलानिलतेजसां,
वाकाशस्यापनीवाती हृष्टं लिङ्गं अथाकमम् ।
लघुत्वं सर्वमेतैतन् सार्वभेद्विगीचरम् ।

Charaka-S'áirasthāna, Chap. I.)

(cf. the elaborate enumeration of physical characters quoted in Vijñāna-bhikṣhu, Yoga-Vārtika, Sutra 42, Pada I ;—also Varavara's commentary on Tattva-traya Aśhī-prakarana).

The Mahā-Bhūtas—mechanical mixtures :—
Susruta notes that each of the gross Bhūtas (Mahā-bhūtas) is found mixed up with the other Bhūtas ;—*e. g.*, the Mahābhūta Ākasa is the receptacle (or vehicle) of air, heat-and-light, and water vapour ; the Mahābhūta Vāyu, of water-vapour, light-and-heat, and even fine particles of Earth held in suspension ; the Mahābhūta Tejas, of earth-particles in the shape of smoke, and also water-vapour.

(चन्द्रोऽन्यानुविष्टानि सन्धान्येतानि निर्दिशेत्—Susruta, S'ācira-
sthāna, Chap. I.) चन्द्रो पुनः चन्द्रया व्याचक्षते । चाकाशे एवम-
दहन-तोषानि । वायौ तेलीऽम्बुनी । भूपि चक्षुताविशेषकः । भूमिपि
धूनादिरूपेण तेजसि । तिलीदृशं पानीयरूपि ।—Dalvaṇa on
Susruta, loc. cit.)

Mono-Bhautic Earth-substances :—Charaka and
Susruta regard the following as Earth-substances—
Gold, the five Lohas (silver, copper, lead, iron and
tin) and their 'rust', arsenic, orpiment, various
mineral earths and salts, sand, precious stones,
(Charaka, Sūtrasthāna, Chap. I. Cf. also Susruta,
Sūtrasthāna, Chap. I—वाचिदाः सुवर्षरक्तमणिमुक्तासनः-
मितामलकपाषाणदवः । सुवर्षस्य रक्तं पार्थिवत्वमेवास्तीतिशब्देन दुग्धलकादिक-
स्त्वस्तीतिदिशेति । इति वादिरुह्यात् स्त्रीकमलदिकृतसुषुम्भारितालस्यक-
रेदिकरसाक्षनं प्रसूतीना—Dalvaṇa on Susruta, loc. cit.)

The salts include common salt, saltpetre, etc.
Susruta mentions, the alkalis, borax, natron,
Yavakshāra (carbonate of potash) etc. The Audbhida
salt, an inflorescence of the soil, stands for *raśa* (खीरिदं
पायलस्यैव दध्नातंभूमितः सद्यम्).

Of these Earth-substances, some were known
to be compounds, *e. g.* the chemical salts of the
metals, collyrium etc. Susruta describes the pre-
paration of the metallic salts. The leaves of the
metals were pasted over with the salts, and then
roasted (चक्षुक्ति) (Chikitsāsthāna, Chap. 10).
These metallic salts are therefore mono-Bhautic
Earth-compounds. Susruta also gives the preparation
of mild and caustic alkalis. (Sūtrasthāna, Chap. 11.

Origin of precious stones :—Some hazarded the guess that the precious stones are rocks (or earths) metamorphosed by natural process in the course of ages (Varāhamihira—वेदिकः प्राकृत्यलानाम् केचित् भुवः सदाशत—Utpala notes, —उत्पलं वारः काश्चाद्विष).

Ap-substances, simple and compound :—

Susruta, following Charaka, enumerates various classes of Ap substances (द्रव्यम्) as follows :—waters, acids, milks, curds, butters, oils (vegetable as well as animal), fats, honeys, molasses, alcoholic liquors, urines etc.

Pure Ap (Mahābhūta) is tasteless and the six tastes are developed when the Mahābhūta Ap enters into combination, mechanical or chemical, with other Mahābhūtas. Susruta notes that various kinds of Earths are dissolved in the waters of different localities, and where the particles so dissolved are predominantly Earthy, the water tastes acid or salt,—where predominantly watery, the resulting taste is sweet,—where the Earth particles are mixed up with Tejas, the water tastes pungent or bitter etc. Such is the case with mechanical mixtures. In the case of bi-Bhautic or tri-Bhautic compounds Charaka mentions that substances with Mahābhūta Ap predominating in their composition taste sweet; with Mahābhūtas Earth and Tejas predominating, acid; with Mahābhūtas Ap and Tejas predominating, salt; with Mahābhūtas Vāyu and Tejas predominating, pun-

gent ; with Mahābhūtas Vāyu and Akāśa predominating, bitter ; and with Mahābhūtas Vāyu and Earth predominating, astringent (Charaka, Sūtrasthāna, Chap. 26,—cf. Susruta, Sūtrasthāna, Chap. 42).

In fact with the exception of Susruta's waters which are mechanical mixtures, or rather solutions, all these Ap-substances are organic products and, as such, penta-Bhautic, i. e. compounded of all the five Mahābhūtas, and the particular 'taste' which is developed depends on the relative proportion of the Mahābhūtas, and the predominance of one or more of them in the penta-Bhautic compound in question.

Qualities of Compounds.—The isomeric modes of each Mahābhūta have specific colours, tastes etc. due to their structure, i. e. the arrangement of their atoms, and the physico-chemical characters of compounds whether of the same or of different Mahābhūtas result from the collocation in unequal proportion of the different forces latent in the atoms of the component substances. Charaka adds that the varied forms (textures) and colours of organic substances, whether vegetable or animal, are derived in the same way. एवमेतेषां रसतां षट्समुपपन्नं क्षुनादिरैकविधैवात् नष्टाभूतानाम् । सूक्ष्मानि च स्थावराजङ्गमानां नानावर्णाकृतिविधेयाः ।

Susruta ignores Charaka's distinction between Mahābhūta and subtile Bhūta, and views every

substance as in reality penta-Bhaotic and it is only the relative predominance of a particular Bhūta or Bhūtas in any substance that determines its class. (एषिष्यन्नेजीवाङ्काद्यानां समुदायात् इत्यादिनिर्दिष्टः । उत्कर्षस्तु अतिशयकी भवति इदं पविषं इदं काणं इदं तैजसं इदं वायव्यं इदं आकाशीयमिति । Susruta, Sūtras-thāna Chap. 41)

The extant Charaka and Susruta—Succession of medical authorities :—

The extant Charaka and Susruta, the sources of our present information regarding the progress of scientific knowledge in the medical schools of Ancient India, are both redactions of original authorities. The extant Charaka is a redaction by Dridhabala of the genuine Charaka Samhitā which was itself a redaction by Charaka of the original work of Agnivesa, the disciple of A'treya Punarvasu as distinguished from Krishnatreya and Bhikshu A'treya, also well-known medical authorities. The extant Susruta is a redaction by Nāgārjuna of an original work (Vridhha Susruta) by Susruta, the disciple of Dhanvantari. That Charaka preceded Susruta is almost certain. Nāgārjuna was probably earlier than Dridhabala. At any rate, Dridhabala imported into Charaka much of the surgical knowledge which had till then been the traditional heritage of the Susruta school. And in the matter of the surgical treatment of certain diseases, the genuine Dridhabala is often as

advanced as Susruta's, redactor himself. The latter was probably identical with the alchemist Nāgārjuna (Siddha Nāgārjuna), the metallurgist Nāgārjuna (author of a treatise on metallurgy, *Lohasāstra*), and the Buddhist Nāgārjuna, author of the *Mādhyamika-sūtravṛtti*. Charaka and Susruta continued to receive additions after Dṛdhabala and Nāgārjuna, and even after Vāgbhata, but the whole of the extant Charaka is probably much earlier than the commentator Chakrapāni, and the whole of the extant Susruta earlier than Dalvana, the commentator, and Mādhava, the author of *Rogvinischaya*. The extracts in Vāgbhata make it certain that the passages I have quoted or shall quote from the *Sūtrasthāna* and *Sāhacrasthāna* of Charaka and Susruta cannot be later than the sixth century of the Christian era.

Preparation of Chemical Compounds.—The knowledge of chemical compounds and of their preparation continued to make progress in the Charaka and Susruta Schools. The great metallurgist, Patañjali, in his treatise on Metallurgy (*सौवर्ण्य*) gave elaborate directions for many metallurgic and chemical processes specially the preparation of the metallic salts, alloys and amalgams, and the extraction, purification and assaying of metals. Probably it was Patañjali who discovered the use of the mixtures called *Vidas*,

which contained aqua regia or other mineral acids in potentia. Unfortunately Patañjali's *magnum opus* appears to have been lost, but extracts from it are frequently found in mediaeval works on Medicine and Rasāyana, which leave no doubt as to its remarkable scientific value. The metallurgist Nāgārjuna advanced the knowledge of chemical compounds by his preparations of mercury. The *Harsacharita*, in the seventh century, relates a fable concerning this Nāgārjuna, and speaks of him as a friend and contemporary of Śātavāhana. The relative priority of Patañjali and Nāgārjuna is a vexed question in the history of metallurgy. That Nāgārjuna's *Lohasāstra* was earlier than the final redaction of Patañjali will appear from the following circumstances:—(1) Chakradatta in his summary of Nāgārjuna mentions that the chemical process of testing pure iron must be repeated twice before it can be regarded as decisive, whereas Śivadāsa Sen's extract from Patañjali shows that the latter directed the process to be repeated seven times; (2) Patañjali in the *Abhira-viḍhi* (mica operation) adds mercury, which in this particular operation is wanting in Nāgārjuna's recipe (cf. Chakradatta, and Patañjali as reported in the *Yogaratnākara-samuccaya*); and (3) Nāgārjuna is quoted in the earlier compilations, Patañjali in the later.

Early in the sixth century, Varāhamihira in the

Vrihat Samhita gives several preparations of cements or powders called Vajra-lepa "cements strong as the thunderbolt;" and there was ample use for these in the temple architecture of the Buddhist period, the remains of which bear testimony to the adamant strength of these metal or rock cements. (वासोदहस्येऽवसमीक्षित-
प्रतिभासु कुचकुपेषु सज्जो दासव्यो रसैश्च सावुहस्यवी । Chapter 56, *Ibid.*). Varāhamihira also alludes to the experts in machinery (यन्त्रविदः, यन्त्रज्ञः) and the professional experts in the composition of dyes and cosmetics (रामयन्त्रविदः Ch. 16, also Ch. 15). I would also refer to the interesting Chapter on Perfumery (Ch. 76) where Varāhamihira gives various recipes for artificial imitations of natural flower scents as of the essence of Vakula, Utpala, Champaka, Atimuktaka &c., arranges compound scents in a sort of scale according to the proportions of certain ground essences used in their preparation, and determines by the mathematical calculus of combination (लीटकनसार) the number of variations of the different notes in this scale. To these classes of professional experts were due three of the great Indian discoveries in the chemical arts and manufactures which enabled India to command for more than a thousand years the markets of the East as well as the West and secured to her an easy and universally recognised pre-eminence among the nations of the world in

manufactures and exports :—(1) the preparation of fast dyes for textile fabrics by the treatment of natural dyes like *Mañjishtā* with alum (गुरी मञ्जिष्टा रमणवर्ण) and other chemical (e. g. sulphate of iron) also cow-dung (cf. the "cowdung substitute", Roseo); (2) the extraction of the principle of indigotin from the indigo plant by a process which however crude is essentially an anticipation of modern chemical methods; and (3) the tempering of steel in a manner worthy of advanced metallurgy, a process to which the mediæval world owed its Damascus swords. It was this applied chemistry much more than handicraft skill which gave India her premier position in the middle ages and earlier (indeed from Pliny to Tavernier) in exports and manufactures; for in handicraft skill as in design and workmanship, great as were her merits, India came to be surpassed by her disciples China and Japan.

The *Vasavadattā* and the *Dasakumāra Charita* in the sixth century allude to the preparation of a mass of fixed or coagulated mercury (पारद-विण्ण इव कास्ययतुवादिनः—वासवदत्ता); a chemical powder, the inhalation of which would bring on deep sleep or stupor (श्रीमच्छर्मा—दशकुमारचरित); a chemically prepared stick or wick for producing light without fire (श्रीमद्वर्षिका—दशकुमारचरित); and a powder which like anæsthetic drugs or curare, paralyses

sensory and motor organs (*संयमनकर्षणानि इन्द्रियाणाम्* — *संयमनकर्षणानि इन्द्रियाणाम्* इदं). *Varinda* (circa 950 A. D.) notices the preparation of sulphide of mercury (*रसायनकर्षण*) composed of one part of sulphur, and half its weight of mercury ; and also of cuprous sulphide (*सर्पटिक्तम्*). *Chakrapani* (circa 1050 A. D.) mentions the preparation of the black sulphide of mercury, "by taking equal parts of mercury and sulphur".

The *Rasarnava* (circa 1200 A. D.) notices the colours of metallic flames, probably after *Patanjali* ; e. g. copper gives blue flame ; tin, pigeon-coloured ; lead, pale ; iron, tawny ; blue vitriol, red. It may be noted that the *Rasarnava* regards mercury as a penta-Bhautic substance.

The *Rasaratna-samuchchaya* divides the mineral kingdom (Earth-substances, simple and compound) into the following classes :— (1) The eight *Rasas*, mica, pyrites, bitumen, blue vitriol, calamine, etc. (2) The eight *Uparasas* (useful in operations of mercury), sulphur, red ochre, green vitriol, alum, orpiment, realgar, collyrium, and medicinal earth, to which may be added the eight *Sadharana Rasas*, sal-ammoniac, cowrie, cinnabar, rock vermilion, etc. (3) The gems, diamond, emerald, sapphire, cat's eye, sun-stone, moon-stone, pearl, etc. (4) The metals,

gold, silver, iron, copper, lead, tin, and the alloys—brass and bell-metal. Other Earth-substances are six salts, three alkalis, mineral earths, and several poisons (cf. vol. I, pp. 32-95).

Chemical compositions and decompositions—metallurgic processes.—In these writings, we frequently come across instances of chemical composition and decomposition, by processes, more or less crude, of calcination, distillation, sublimation, steaming, fixation, etc. (भक्षीकरण, जर्दपादन, खेदन, सन्नन etc.); e.g. the preparation of perchloride of mercury by taking common salt and mercury (रसकर्पूर—पारदस्य सेतु-भक्षीकरणे षट्द्विकारः); of sulphide of mercury (द्विदुग्ध) by taking sulphur and mercury; of Sindūra from lead (सिन्दूरं नागसन्धनम्—Amarakosha sixth century A. D.);—of the medicinal compounds, Svārṇa-sindūra and Rasasindūra, with mercury, sulphur and gold, where gold may have been fancied to influence the resulting compound in some mysterious way, either as a 'dynamic' or as a catalytic;—also the extraction by chemical decomposition of mercury from sulphide of mercury (द्विदुग्ध,—vide रसरत्नसमुच्चय); of copper from sulphate of copper (तुल्य, ससक) by heating this substance with one-fourth of its weight of borax (Rasaratna-samuchchaya,—cf. Bhāvaprakāsa, गुणं

तु तास्मैवधातु किञ्चित् तास्मैव तद्वदति); of zinc (वदाम्, जङ्गद) from calamine (रसक—Rasārnava); of copper from pyrites (राजिक, विरुद्ध, etc.—Rasārnava, (though the golden pyrites were supposed to be a semi-metal of gold, containing some gold along with the essence of copper)—the purifications of mercury by repeated distillation from lead and tin with which it was wont to be adulterated in the market. The various metallurgic processes described are—extraction, purification, killing (formation of oxides, chlorides and oxy-chlorides for the most part), calcination, incineration, powdering, solution, distillation, precipitation, rinsing (or washing), drying, steaming, melting casting, filing, etc. to all which each of the known minerals was successfully subjected by the use of apparatus and reagents and the application of heat in different measures (खरपाक—सञ्जयपाक—and वदुपाक),—methods which, if often crude, especially from the absence of independent and isolated mineral acids, were yet in several instances remarkably simple and effective, and which, after all by the use of various Vidas potentially containing mineral acids aqua regia, sulphuric acid, hydrochloric acid, etc.) virtually accomplished the practical ends kept in view. To these were added several special processes for mercury (e. g. fixation), bringing up the number of mercurial operations to nineteen.

It may be noted that the mixtures called *Vidas*, which potentially contained dilute mineral acids, were regularly employed not only in killing the metals (forming their oxides and chlorides), but—what is of fundamental importance—for purposes of chemical decomposition of metallic salts, etc., and the extraction and purification of metals.

Organic Compounds.—Organic Compounds are either vegetable or animal substances (खावर जडन सूत). The molasses, the fermented liquors, the saps and juices of plants, fruit acids, vegetable ashes and alkalis together with the tissues of plants are vegetable compounds (बीजिद खावर सूत). Honey, milk, curd, butter, fat, bile, urine, and other excreta, together with the organs and tissues of animals, are animal substances. Charaka notices vegetable as well as animal oils. The viscous (oily) substances are classed under four heads—butters, oils, fats, and marrows (सर्पिणील वसा मज्जा सेढी दहदगुर्विच). Salt may be either mineral or vegetable salt.

Susruta divides poisons into two classes—Vegetable and animal, but several poisons expressly termed mineral poisons (मातृविष) are included in the first class.

All organic substances, whether animal or vegetable, are penta-Bhautic, being compounded

of greater or less proportions of the five *Mahā-bhūtas*.

Taking the human body Charaka finds that the foetus is composed of sixteen organic substances, viz. four, composing the Sperm-cell which comes from the male; four composing the germ-cell which comes from the female; four added by the transformation of the nutritive material, and finally, four kinds of subtile matter, which together form the vehicle of the conscious principle. As to the four organic substances which compose the sperm-cell, or the other four which compose the germ-cell, it is not clear whether in Charaka's view they are also in their turn compounded of less complex organic substances, or whether their constituent elements are inorganic penta-Bhautic compounds.

The tissues that appear in the course of developments of the foetus are further transformations (higher compounds) of these foetal substances. All the component substances of the body are penta-Bhautic compounds, though sometimes they are assigned to the particular *Bhūtas* which predominate in their composition, *e.g.* bile to *Tejas*, lymph, chyle, blood, fat, urine, sweat and other secretions to *Ap*, and skin, flesh, bones, nails, hair, etc. to *Earth*.
(इहं वायुद्विभूतयुग्मपादवत् ।—गर्भस्य चत्वारि चतुर्विधाणि सूतानि

मातृपितृसंश्रानि आहारानि आत्मज्ञानानि चैव et seq. Charaka, Sâkrirasthâna, Chap. II. vide also Charaka, Sâkrirasthâna, Chap. VII. cf. Gaṅgâdhara's Jalpakalpataru, विषं हृत्वीर्यं भूतं शरीरारम्भकलैः प्रधानवक्षःभूत-
विकारात्मकं लैः स्वरूपमभिधेयम् । कफवतुर्घै भूतमायुः शरीरारम्भकलीम-
प्रधानवक्षःभूतविकारविधीः । शरीरे तु पञ्चमहाभूतविकारसमुदायात्मकम् ।
Cf. Charaka Sâkrirasthâna, Chap. IV. मातृजादयोऽपि पञ्च
महाभूतविकाराः ।)

Fœtal Development (after Susruta). The ovum fertilised by the sperm-cell and developing under the influence of animal heat forms successive layers and tissues even as layers of cells and fibres are formed in wood. First are formed seven layers epithelial and dermal (सप्तलवः), then follow the several tissues (ऊक्षः), the flesh, the vascular tissue, the fat and marrow, the lymphatic (and glandular) tissue, the intestinal tissues, the biliary and the seminal vessels,—tissues which are regarded by some as modifications of the original dermal layers of the ovum (cf. the layers of the blastoderm and their relation to the tissues in Embryology). The tissues are supposed to be developed successively, one out of another, by chemical action or metabolism (पाच), e. g. chyle is transformed into blood, blood into flesh, flesh into fat, fat into bone, bone into marrow, marrow into sperm-cell. The organs are next formed out of the tissues. The liver, gall-

bladder (लोम), spleen and lungs are referred to the blood ; the intestines to the blood, lymph and bile ; the kidneys to the blood and fat ; the testicles to the blood, lymph and fat ; the heart to the blood and lymph ; and the tongue to the lymph, blood and flesh. Vāyu, with the accompaniment of animal heat, impels the 'currents' (वीर्यसि) in the system ; Vāyu acting on the flesh gives rise to the muscles, and it is Vāyu again, which, with the essence of fat (or marrow), produces the nerves, arteries and tendons. (तस्य स्रष्टु वरुणीषितस्य वसिष्ठस्यमानस्य वीर्यस्य सनातिकाः सप्तस्यो मयति ।—कथाः स्रष्टुपि सप्त सप्तवति । यथाहि सारः काष्ठेषु क्षिप्तमानेषु दृश्यते । तासां प्रथमा मसिधरा । द्वितीया रक्तधरा । तृतीया मेदीधरा । चतुर्थी श्लेष्मधरा । पञ्चमी पुरीषधरा । षष्ठी पित्तधरा । सप्तमी पदधरा ।—नर्मस्य दहत्तुदीहानौ योपित्तौ ।—et seq Susruta, Sūtrāsthana, Chap. IV.—रसाद्रक्तं ततो मांसं मांसादेः प्रजायते । नैदसीऽसि ततो मज्जा मज्जाः दहन्त्य सन्धराः । Sūtrāsthana, Chap. XIV.)

The following parts (tissues and organs) in the fetus are in a special sense modifications of the four organic substances contributed by the sperm-cell of the male parent ; hair, nails, teeth, bones, nerves, veins and arteries, tendons and ligaments, and the sperm-cell ; the following, of the substances derived from the mother,—skin, blood

flesh, fat, the heart, liver and spleen, kidneys, stomach, intestines, etc.' (Charaka, Sārīrasthāna, Chapter III. यानि खल्वस्य गर्भस्य पितृजानि पितृतः सम्भवतः सन्धवन्ति, तदवस्था केच-यस्यु-मस-लीम-दन्तास्त्रिहिरा-सायु-धमस्यः युक्तमिति पितृजानि । यानि खल्वस्य गर्भस्य मातृजानि यानि च अस्य मातृतः सम्भवतः सन्धवन्ति—तदवस्था त्वक् च लीहितस्य तस्मिन् मेदस्य हृदयं च यकृन् च ग्रीवा च हस्तौ च पुरीषाधानं च आमाशयश्च इति मातृजानि ।)

Chemistry of Digestion—The food we eat contains five classes of penta-Bhautic organic compounds. From their radicles or predominant elements, the substances are named Earth-compounds, Ap-compounds, Tejas-compounds, Vāyu-compounds and A'kāsa-compounds. The Earth-compounds supply the hard formed matter of the body, the Tejas-compounds give the animal heat (or the metabolic heat), the Vāyu-compounds are the sources of the motor force in the organism, the Ap-compounds furnish the watery parts of the organic fluids, and the A'kāsa-compounds contribute to the finer etheric essence which is the vehicle of the conscious life. Roughly speaking, the Earth-compounds answer to the nitrogen compounds in the food, the Tejas-compounds to the hydro-carbons (heat-producing) and the Vāyu-compounds to the carbo-hydrates (dynamic). The Ap-compounds are the watery parts of food

and drink. The flesh, for example, is a tissue composed principally of the Earth-compounds, the fat of the Earth and Ap compounds, the bones of Earth Vāyu and Tejas compounds. The Tejas compounds predominate in the composition of the blood. For purposes of digestion it is stated that different operations of the metabolic heat (perhaps different digestive fluids are also meant) are required to digest the different substances in the food.

The course of metabolism is described as follows:—The entire alimentary canal is called Mahāsrotas (the great channel).

The food goes down the gullet by the action of the biomotor force, the Prāna-Vāyu.

In the stomach (*śāntāna*) the food becomes mixed up first with a gelatinous mucus (*केपीयूतं कर्षं*) which has a saccharine taste, and then gets acidulated by the further chemical action of a digestive juice (*विदादादन्तं रसः*)—evidently the gastric juice is meant. Then the biomotor force, the Sāmāna Vāyu, begins to act and drives down the chyle by means of the Grahani Nādi to the Pittāsaya (duodenum), into which bile comes down from the liver, and thence to the small intestines (the *अन्तर्गता*). In these, the bile (or rather the digestive substance in the bile as opposed to the colouring element) acts on the chyme, and converts the latter into chyle (*रस*), which has at first

a Katu taste (pungency). This chyle contains in a decomposed and metamorphosed condition all the penta-Bhautic organic compounds, viz. tissue-producing Earth-compounds, water parts or Ap-compounds, heat-producing Tejas-compounds, force-producing Vāyu compounds, and lastly, finer etheric constituents which serve as the vehicle of consciousness. The essence of chyle (क्षयमान) from the small intestines is driven by the biomotor force, the Prāna Vāyu, along a Dhamani trunk (cf. the thoracic duct) first, to the heart (which is a great receptacle of chyle), and thence to the liver (and the spleen), and in the liver, the colouring substance in the bile acts on the essence of chyle, especially on the Tejas substance therein, and imparts to it a red pigment, transforming it into blood. But the grosser part of chyle (अक्षयमान) proceeds along the Dhamanis, being driven by the biomotor force, the Vyāna Vāyu, all over the body.

When the blood has been formed, the essence of chyle in the blood, acted on by Vāyu (biomotor force) and Mānasaṅni (the flesh-forming metabolic heat), forms the flesh tissue, the Earth-compound of the food substance especially contributing to this tissue. Of the flesh tissue thus formed, the grosser part goes to feed or replenish the flesh tissue all over the body. The finer essence of flesh in the

blood in the chyle, acted on again by Vāyu (biomotor current) and the fat-forming metabolic heat (विहोऽग्नि) in the menstruum of lymph (कर्म वसाविज्ञ), receives viscosity and whiteness, and produces the fatty tissue, the Earth-compounds and Ap-compounds of the food especially contributing to the product. This fat in the chyle (or blood), or rather the grosser part of it replenishes the fatty tissue of the body, but the finer essence of fat in the flesh in the blood in the chyle, acted on by Vāyu (biomotor current) and the marrow-forming metabolic heat, in the menstruum of lymph (हृत्प्राण), becomes hard (or crystalline), and forms bone, the Earth, Vāyu and Tejas compounds contributing principally to the product. The essence of the fat fills the hollow channels of the bones, and acted on again by biomotor Vāyu and metabolic heat, becomes transformed into the marrow. The marrow is transformed into the semen, which is conveyed down by means of a pair of Dharmatās (ducts) (वृक् वसनाङ्ग), lodged in its receptacles (वसनाङ्ग—वसनी) and discharged by means of another pair of ducts (वृक् विवर्धन). The semen, or rather all the elements in their finer essence, give off Ojas, which returns to the heart, the receptacle of chyle and blood, and again floods the body, and sustains the tissues, thus completing the wheel (or self-return-

ing circle) of metabolism (वर्तमानवृत्त चक्रवत्. Cf. Charaka and Vagbhata).

It is to be noted that, throughout, the fluid in the chyle (or blood) acts as the menstruum, though occasionally the lymph, which is itself a derivative from the chyle is added as in the case of the fatty tissue and the marrow; and that each preceding element or constituent of the body (प्राग्-मरीचरश्मकषात्) takes up the proper organic compounds from the food-chyle to form the next element or tissue. Throughout also, the chemical changes are due to the metabolic heat which breaks up the compounds and recombines, but the operations and even the vehicles perhaps of this heat are different. For example, these heat-corpuscles in the biliary ducts produce the bile, but the bile secretion is supposed to contain two distinct substances, (1) a digestive fluid in the duodenum (द्विचक्षुः) which acts on the chyme to produce the chyle, (चक्षुः पक्षुषाचक्षुः द्विचक्षुः); and (2) a colouring bile substance in the liver which adds a red pigment to the chyle and transforms it into blood (रक्तकायं द्विचक्षुः). Besides, there are three other biles, of which the aqueous humour in the eye is supposed to be one (अक्षौषकद्विचक्षुः) helping in the formation of visual images (दृश्यमानवृत्तम्). This is the view of Dhanvantari and his school, but A'treya holds there is no

evidence that the bile really performs the first (digestive) function, for this can be accounted for by the animal heat arising from the working of the whole bodily machine. There are three different hypotheses regarding the course of metabolism and the successive transformations of the chyle

(चोदधिकार-केदारिकृत्यायाय प्रवृत्तिकरीत्यादेति द्विषा प्राणोदक-जनः—Chakrapāṇi, Bhānumatī, Sūtrasthāna, Chap. 14, Śloka 10 ; also his commentary on Charaka, Sūtrasthāna, Chap. 28), but my account is based upon the second hypothesis which has the preference of Chakrapāṇi (चरकः). It may be added as a curiosity that each element of the body (वायु) under the metabolic heat is supposed to give off a finer essence (सूक्ष्मभाण्ड) which serves as the material of the next succeeding element, and a dross (गल), which forms some of the excreta in the body (including the nails, the hair, etc.), besides retaining its own substance (the gross or main part) which is driven along by the Vāyus (biomotor or vital currents) or by the Srotas to its destination in the body. Some idea of circulation appears to have been entertained, for the heart which receives and then sends down the chyle

by the Dhmanāś gets it back transformed into food, and the Ojas also proceeds from the heart and returns to it along with the chyle and blood. (Cf. Vāgbhata—वात इत्यादि द्विषाः रसाकलं बीजः

अभिरक्षन्त्यः) । पचन्भूतान्मन्त्रे देहे चाक्षरं पाचभौतिकः । विपक्षः पचधः) सम्भरगुणान् स्वागभिरुर्वेत् । *Susruta, Sūtrasthāna, Chap. 46. Cf. also* विद्यत्प्रवर्णनात्मा इतिमात्रेति नास्तः । चाद्यैयमेव यदृश्यं तेषां पित्तमुदीर्यते । *Ibid., Chap. 41.* भौतान्धार्यं ववाचयाः पचोपायः समाभसाः । पंचाक्षरगुणान् स्वात् स्वात् पार्थिवादीन् पचन्त्यतः । यथाऽन्ते तै च पुच्छानि पक्ता मूल- गुणान् प्रयक् । पार्थिवः पार्थिवानेष त्रेषाः प्रेषाश्च देहमात् । अतिरिक्ता गुणा रक्ते रक्तेर्गोष्ठे तु पार्थिवाः । मेदस्यच स्रवसाश्च शुक्लानिलनिमग्नम् । *Charaka, quoted by Dairvana.* चादौ पक्वद्रवसम्यक् सधुर्भीभूतमीरयेत्, केचोभूतं कफं दातं विदाहदक्षतां ततः । वायुना समानाख्येन चक्षुषीमभिनीयते । पक्षो विपक्षरा नाम वा कक्षा परिकीर्षिता । कामपक्वामयान्त्राः यदक्षी साभिधीयते । अम्यविहानमस्तस्य यद्व्याधुदक्षी तदा । मुक्तमामाश्रये यदा वा विपाच्य मयस्यधः । यत्परस्यमला तत्रमाममेव विमुच्यति ।... यदस्य पक्व पित्तम् पाचकाख्यं प्रेरितम् । दीपधातु-कलादीनामुद्देश्या- लेषशसत्तम् ।... तेजीरसान् । सर्वेषामस्युज्जानां यदुच्यते । पित्तोपधा सशरीरं रसो रक्तत्वमृच्छति । वायुप्रतेजसा युक्तं रक्तं मांस- त्वमृच्छति । श्लेष्माणं च समाश्रित्य मांसं वातप्रियुतम्, क्षिरतां पाण्य मूर्ध्ना च मेदो देहप्रभिरावते । शुक्लमम्यनिलादीनां सहानः प्रेषावततः । खरत्वं प्रकरीत्यस्य जायतेऽपि तस्यै नृधाम् । करोति तत्र कीर्ष्यमस्यं मध्ये सतीरसः । मेदसा तानि पुष्पान् केचो मज्जां ततः कृतः । यथाप्यज्जघ्न यः केचः यक्तं संजायते ततः ।

Charaka—*Dridhakala Samhita*, quoted by Aruna in his commentary on Vāgbhata. यथा किदारनिषक्तं कुल्याशले प्रत्याधत्ता किदारोमाप्रापयति, तथा रक्त एव प्रथमं रक्तं प्रापयति। तथा रक्तस्थानं च स्रवन् रक्तमादत्तं रक्तमपेक्षितं च अनुभवति। रक्तं च रक्तसमासेन कोकिनामेन च यं पीययति। ततो रक्तमाप्राप्य मांसमाप्रापयति, एवमुत्तरोत्तरधत्तुं रक्त एव प्रापयति। (Chakradatta, Bhanumati). This passage shows that the 'venous blood' was conceived to be chyle-essence mixed with blood, and that the circulation of the chyle so far as it was held to contribute its quota to the constituent elements and tissues of the body was really supposed to be identical with the circulation of the blood (ततो रक्तमाप्राप्य मांसमाप्रापयति). This will be abundantly clear from the following account of the course of the chyle and the blood :—

ततः सारभूतखाद्वाररक्तस्य द्वौ भागौ भवतः। स्थूलः सूक्ष्मः... ततः सूक्ष्मो भागः प्राणवायुना वेरितो धमनीमार्गेण हरीरारम्भकस्य रक्तस्य स्थानं यत्नत् प्रोदधत्तं गत्वा तेन सह मिलितो भवति। ततः प्राक्तन-रक्तधत्तौ एव तिष्ठति।.....ततः सारभूतस्य खाद्वार-रक्तस्य द्वौ भागौ भवतः। स्थूलः सूक्ष्मः। सूक्ष्मो भागो रज-काश्लेन पित्तं रक्तोक्तः हरीरारम्भकं रक्तं पीडयन् व्यान-वायुना वेरितो धमनीभिः संपरन् कललहरीरगतानि रवेरपि शुच्यति। ततः सूक्ष्मो भागः व्यानवायुना वेरितो धमनीभिः शिरानिध-हरीरारम्भकाणि मांसानि याति। at seq.

This finer essence of chyle which nourishes the flesh must also be carried in the blood, on the 'irrigation channel' hypothesis (वेदरीकुल्यान्तः). (For diagrams of the central circulation and the sympathico-spinal nervous system, *vide* my Paper on Hindu Anatomy and Physiology. The mechanism of life and the inheritance of specific and other congenital characters are also dealt with in the same paper).

Formation of molecular qualities in chemical compounds :—The Charaka school, which, we have seen, was an offshoot of the Sāṅkhya (cf. Charaka, *Vimānasthāna*, Chap. 8, यथा अद्विजः प्रकाशकः तथा सञ्ज्ञावर्धनं प्रकाशकमिति) ; supplemented the above account of inorganic and organic compounds with a characteristically Sāṅkhya explanation of the formation of molecular qualities by chemical combination. In Charaka's view, the colours, tastes, etc. of the molecules of chemical compounds result from the collocation in unequal proportion and unstable equilibrium of the different forces latent in the atoms (*Paramāṇus*) themselves. (एवमेवेति रसाणां यद्वसुधपदं नूनातिरिक्त-विशेषाद् महाभूतानां । सूक्ष्मानामिव स्थावरजसूक्ष्माणां नाभावव्याप्ति-विशेषाः । Charaka.)

Chemistry of colours.—As an interesting example of the way in which a follower of Charaka would account for the colours of chemical compounds, I may note the explanation given by the late Gaṅgādhara Kavirāja Kaviratna in the *Jalpakaḥpataru*, a commentary on the *Charaka-Saṃhitā*, published at Calcutta in 1860, premising that the Kavirāja's view is pure and genuine Charaka doctrine. Gaṅgādhara begins with a simple statement. The qualities of the atom, he writes, tend to produce similar qualities in the molecule. A molecular quality is therefore the result of the conjunction or opposition, as the case may be, of the atomic tendencies. When, for example, the five Bhūtas combine to produce an organic compound (the human body), Tejas, Ap and Earth tend to produce red, white and black respectively, but in the body (compound substance) the yellow colour may happen to be produced as the result of these tendencies in that particular proportion and collocation. The point to note here is that the molecule forms a fresh collocation, *redistributes the Mass and Energy*, and sets up new forces in the system which coming into play modify the potencies (or tendencies) in the component atoms and thus determine the resultant. This is elaborated into a curious but complete theory of the colours of chemical compounds.

The colours (and other qualities) of a simple substance (an isomeric mode of any Bhūta) are the result of the potencies lodged in that particular collocation of Mass, Energy and Essence. Now when two such substances unite, their colours etc. tend to be produced, but the combination brings on a fresh distribution of Energy, Mass and Essence, and the forces thus set free may powerfully modify or even extinguish the separate tendencies or potencies of the component simple substances. For example, when we prepare a collyrium by mixing equal parts of sulphur and mercury (the black sulphide of mercury), we find the resulting compound black. To explain this, it has to be remembered that each of the substances (sulphur and mercury), contains Sattva (Essence), Rajas (Energy) and Tamas (Mass) in different proportions, and that predominant Tamas (Inertia, Mass) always produces black, predominant Sattva (Essence) white and predominant Rajas (Energy) red. Now in the black sulphide of mercury, the white of the mercury tends to produce white and the yellow of the sulphur yellow ; and if these tendencies were not obstructed, the result would be a mixed colour. But, in the particular collocation in question, the Tamas of the mercury becomes intensive (तीव्र), and the black of the now intensive Tamas

extinguishes the white in the uncompounded mercury, which was due to prevailing Sattva, as well as the yellow of the uncompounded sulphur, which was due to the combined operation of white-producing Sattva and red-producing Rajas. Again, when, with proper apparatus and by the application of heat, we combine mercury and sulphur to produce the red sulphide of mercury, the resulting colour is explained by the fact that in this new collocation the Rajas (Energy)—probably of the mercury, though Gaṅgadhara does not specify—becomes intensive (*दीप्त*), and extinguishing both the white-producing Sattva of the mercury and the yellow-producing Sattva-Rajas of the sulphur, imparts a red colour to the compound. In these cases, as also in the formation of red by mixing powdered turmeric with lime, i.e., whenever a new colour is produced in the compound it is to be explained by the dominance of Tamas, Rajas or Sattva, or their combinations, and the extinction of the uncompounded tendencies (or potencies) by the forces set free in the new collocation. But there are other cases where the colour of the compound is a mixed colour resulting from the colours of the combining substances, e.g., when sulphide of mercury and calcined tin are mixed, the resulting colour is evidently a mixed one (*पांशला*, pink), which is

easily explained by the colours of the component elements (the red of the sulphide of mercury and the white of the calcined tin). In the same way, is a mechanical aggregate, as in a piece of cloth, the colour is white, where the threads are white.

(तत्कारणं पृथिव्यादिद्रव्यावस्थादुष्ठा गत्यादयः खलु स्वस्वातीर्थं गन्धविशेषादिकं आरभमाणः उदाहरमाणं मत्स्यविकातीर्थं कार्ये आरभणं कारणं अङ्गारादिकं गुणानि समग्रं कुर्वन् इत्या कुर्वन् न इत्या स्वातीर्थं गुणविशेषं आरभते । यथा पारदगन्धकीः संयोगे कज्जलीमूतद्रव्ये पारदस्य गुणः गुणविशेषं आरभमाणः गन्धकस्योतः पीतमारभमाणः पारदस्योत्थेन तेजस्यमारभमाणेन विरोधिना बध्यते । सर्वत्रैव योक्तुं सत्त्वगुणयोगिकं रजोगुणयोगिकेन तेजस्येन विरोधिना बध्यते । गन्धकस्योत्थो च लोहितयुक्तो रजःसत्त्वयोगिको बध्यते । तयोः युक्तलोहितवत् तेजस्यः समानयोगिः कृणुः अभिव्यज्यते । इति पारदगन्धकीभयात्कते कार्यं येनपीतमेतनेन संश्रान्तं कार्यं यदवधे तत् तौत्सगुणेन बध्यते, तत्कारणं युक्तलोहितं इत्या । एवं हिदुषु पारदगन्धकाभ्यामारभमाणे गन्धविशेषे वङ्गना पचमाने रजोवङ्गलीनिकेन तौत्सेन सत्त्वतमयोगिकौ युक्तकणौ बध्यते । पारदस्ययुक्तगन्धकस्योत्थमिलनेन संश्रान्तं कार्यं वधे च बध्यते । रजोयोगिरजोहितं च अभिव्यज्यते इति । एवं हरिद्राचूर्णसंयोगेऽपि लोहितं अभिव्यज्यते चूर्णसत्त्वयोः हरिद्रास्य युक्तकणवधे । अथ अथये यथा—हिदुःशतवृक्षभक्ष्यसंयोगे तेजवीहितवर्धनेन समयात्मकं भवति पाटनवधे, न च तत्र हिदुःशत

खीदित्वं दहनमस्यं ग्रीहा' न केनापि बध्यते। एवं यत्तद्व्य-
तिर्गन्तव्यस्य ग्रीहामेव।) (Jalpakaalpataaru, Sūtrasthāna-
of Charaka, pp. 198-200; edition published
by Bhubanschandra Basak, Calcutta, Samvāda-
ratnākara Press, Sanvat 1925.) This is quite
in a line with Charaka's explanation of the tastes
of chemical compounds which has been already
noticed.

Parināma-vāda versus A'rambha-vāda : Charaka's
view of the formation of a new quality or a new
substance is based on the Sāṅkhya teaching as to
the conservation and transformation of Energy,
and brings chemical synthesis in a line with
evolutionary change (परिवर्तन). On this view, a
new substance may arise by spontaneous or isome-
ric change, i.e., by the inter-play of Energies within
the system of any given substance, in the absence
of any action from without. New qualities like
new substances are only readjustments of the
old, and continual changes are going on by
spontaneous disintegration and recombination.
Opposed to this evolitional view of chemical
synthesis is the Nyāya-Vaiśeṣika doctrine of
A'rambha-vāda, according to which no change of
substance or quality, no effect, in short, can take

place except by the action of one component element (substance or quality) on another. A binary molecule, for example, cannot possess any 'specific quality' (विशेषगुण) of a kind not represented in each of the two component atoms. In the cosmic process, no atom can exist free and uncombined with another atom, and every 'specific quality' in a substance can be ultimately analysed into the union of two 'specific qualities' of the same class in two ultimate particles which cannot be further divided. A single colour, smell or taste in a single particle, until it can link itself on to another specific quality of its own class in a second particle, cannot characterise any substance formed by the union of these particles as material causes. Hence an Earth-atom cannot unite with an Ap-atom, to form a new substance of which both the particles must be equally regarded as material causes. At any rate, such a compound, if effected, would be smell-less, as of the two constituent atoms, only one, viz. the Earth-atom, possesses smell. A compound of Earth and Vāyu would be smell-less, colourless and tasteless, and so on. The Nyāya-Vaiśeṣika does not deny that there may be compounds of different Bhūtas, nor does it deny the causal operation of specific qualities as efficient or energising (dynamic) causes (उपस्थानक, निमित्तकारण) but it refuses to place

these compounds on the same footing as compounds of isomeric modes of the same Bhūta; and it accepts the 'material' causality, in such cases of only one of the Bhūtas, regarding the others as 'co-efficients' (निमित्तकारण).

The earlier Sāṅkhyas including the medical schools of ancient India brushed all this aside as a distinction without a difference. The Vedantists, as we shall presently see, flouted this doctrine of A'rambha-vāda. The Jainas, in opposing this Vaiśeṣhika view of atomic combination, hit upon a solution of the problem of chemical affinity. Others again, found out a *via media*. They held, as we learn from the reports of Udyotakara in the Nyāya-vārtika, and of Vāchaspati Miśra in the Tātparyyafikā, that a molecule of the structure EA (one atom of Earth and one of Ap) would exhibit some variety of colour and taste resulting from the joint action of the atoms and of their several colours and tastes. But as in the combination EA only the Earth-atom possesses smell, and the Ap-atom is smell-less, and as moreover no quality in a compound substance can result except from the joint action of the similar (potential) qualities of at least two component elements, it follows that a molecule of the structure EA would not manifest the energy of smell potentially contained in the Earth-atom.

Hence, admitting the combination EA for a smell-less compound, the upholders of this view would suppose a molecule of the type E₂A (i. e. two atoms of Earth and one of Ap) to explain any bi-Bhautic compound of Earth and Ap (like the plant saps and fruit juices) which exhibits smell in addition to the peculiarities of colour and taste. (Cf. Vāchaspati's comment on Udyotakara's refutation of this view :—

अयमभिप्रायः । इदित्यवपरमातुः तावदेकं वायुकसारम्भु-
नर्चतः तयोः ऊपरसंस्पर्शेन तद्वारम्भस्यैव अपि गन्धवत्ता-
भावस्तदात् । एवं पार्थिवान् समवेष्ट्वा गन्धस्य एकत्वेन अनारम्भ-
कत्वात् नापि पार्थिवपरमातुस्यैव एकस्य वायव्योपपरमातुः इति
चक्षुषामारम्भकत्वे गन्धवत्त्वोपपत्तिः इति सामर्थ्यं । परमातुर्ना चक्षुषा
अनारम्भकत्वात् । तदाहि तस्य परमातुस्य न कार्यकारणत्वं ।)

Measures of Time and Space. Size of atoms.

The Siddhānta-S'āstramānī gives the following measures of Time :—

30 Kshanas = 1 day, 2 Ghatikās = 1 Kshana,
30 Kalās = 1 Ghatika, 30 Kshatās = 1 Kalā,
18 Nimeshas = 1 Kāshthā, 30 Tatparas =
1 Nimesha, and 100 Trutis = 1 Tatpara.

This makes a Truti of time equal to $\frac{1}{30 \times 100}$ of a second, which is nearly the measure of

the Paramānu of time, as given in the Vishnu-parāna (vide Bhāskara's Siddhānta-Sīromani—
काण्डमाद्यखण्डः) ।

The above measures were in use among the astronomers, but the physicists computed according to the following table given both in Udayana's Kiraṇāvali and Śiṣṭhara's Nyāyakandali :— 30 Mahārtas = 1 day (24 hours), 30 Kalka = 1 Mu-
hūrta, 30 Kāshthas = 1 Kalā, 15 Nimeshas = 1 Kāshthā, 2 Lavas = 1 Nimesha, 2 Kshanas = 1 Lava.

चण्डिका लवः क्षीमा निमेषस्तु लवद्वयम् ।

कष्टादमनिमेषस्तु कष्टा विंशतिः सः कला ।

विंशत्यक्षा तु द्वयोः स्यात् क्षिप्रद्वयद्वयो षड् ।

(Udayana, Kiraṇāvali).

This makes 1 Kshana of the Nyaya-Vaiśeṣika equal to $\frac{1}{15}$ of a second. The Nyāya assumes that the unit of physical change (or the time occupied by any single antecedent step in a causal series before the succeeding step is ushered in) is equal to a Kshana (or $\frac{1}{15}$ of a second). The astronomers were familiar with far smaller measures of time. The astronomical Truṭi of time measures about the thirty-four-thousandth part of a second. This is of special value in determining the exact character of Bhāskara's claim to be regarded as the precursor of Newton in the discovery of the principle of the Differential Cal-

culus, as well as in its application to astronomical problems and computations. This claim, as I proceed to show, is absolutely established; it is indeed far stronger than Archimedes's to the conception of a rudimentary process of integration. Bhāskara in computing the "instantaneous motion" (*anantika*) of a planet compares its successive positions, and regards its motion as constant during the interval (which of course cannot be greater than a Truti of time, though it may be indefinitely less). This *tātkālika* motion is no other than the differentia of the planet's longitude, and Bāpudeva Sāstrī claims that both the conception of the instantaneous motion and the method of determining it plainly show that Bhāskara was acquainted with the principle of the Differential Calculus. On the data before him, Mr. Spottiswoode remarks that Bāpudeva Sāstrī "overstates the case." Bhāskara "makes no allusion to one of the most essential features of the Differential Calculus, viz., the infinitesimal magnitude of the intervals of time and space therein employed. Nor indeed is anything specifically said about the fact that the method is an approximate one." "With all these reservations" Mr. Spottiswood continues, "it must be admitted that the formula he establishes and the method of establishing it

bear a strong analogy to the corresponding process in modern mathematical astronomy" (*viz.*, the determination of the differential of the planet's longitude,—by no means the first step in transcendental analysis or in its application to astronomy). And Mr. Spottiswoode concludes by stating that mathematicians in Europe will be surprised to learn of the existence of such a process in the age of Bhāskara (*circa* 1150 A. D.—born 1114 A. D.). Mr. Spottiswoode's second objection that Bhāskara does not specifically state that the method of the Calculus is only approximative cannot be taken seriously. The conception of limit and the computation of errors came late in the history of the Calculuses of Fluxions and Infinitesimals. For the rest, Bhāskara introduces his computation expressly as a "correction" of Brahmagupta's rough simplification. The first objection (*viz.*, that Bhāskara makes no allusion to the infinitesimal magnitude of the intervals of space and time employed) would be more to the point, if it were well founded. But it is not, and Mr. Spottiswoode's error was due to the insufficiency of the data supplied to him. As a matter of fact, even Bhāskara's unit, the *Truti* of time (or *Paramānu*), is exceedingly small as the very name implies, being about one thirty-four-thousandth of a second of time. And in the passage in which Bhāskara describes the process, he distinguishes

between *Sthūla-gati* and *Sūkshma-gati* (velocity roughly measured, and measured accurately i.e., by reference to indefinitely small quantities, for *Sūkshma*, as we have seen, has always a reference to the *Anu*, the indefinitely small). Indeed he expressly mentions that the *Sthūla-gati* takes only *Sthūla-kāla* (finite time) into consideration, and that the determination of the *Tātkālikī Gati* (*Sūkshma-gati*) must have reference to the moment (*प्रतिपद्यम्*), which is an indefinitely small quantity of time being of course smaller than his unit, the *Truti*. (Cf. इयं किल सूक्ष्मा गतिः यद्य सूक्ष्मा तात्कालिकी कथ्यते.....यदा यावन्नक्षिण्यलक्षदा तात्कालिकया गत्या निविद्याधनं कर्तुं युज्यते । तथा ससीपचाक्षनम् । यदा तु दूरतरक्षिण्यलः दूरचाक्षनं वा चन्द्रस्य गदा चापया सूक्ष्मया कर्तुं युज्यतेः स्पष्टकाकलात् । यतश्चन्द्रगतिः महत्त्वात् प्रतिपद्यं सदा न भवति चतस्रदशे यथै विज्ञेयैः सिद्धितः ;—nothing can be clearer than this conception of 'momentary' motion,—*Bhāskara*, *Siddhānta-S'romani*, *Ganitādhyāya*, *Gatisphutīprakaraṇa* : cf. also *प्रतिपद्यं सा न सदा महत्त्वतः*, *ibid.*, cf. also *Golādhyāya*, *Tātkālikī-karana-vāsantī-prakarana*, where *Bhāskara* points out that the mode of computing adopted by the *Āchārya* (*Brahmagupta*) is a rough simplification. The computation of relative motion and the idea of resolved components of motion were of course familiar to

the astronomers.—(Cf. एष स्यात्कार्येण साधयति इत्यप्यु-
क्तमिति गणितशास्त्रेण । *ibid.*) I may add en-
passant that Bhāskara's formula for the computation
of a table of Sines also implies his use of the
principle of the Differential Calculus.

Measures of weight and capacity. The Amara-
koṣha mentions measures of three kinds—weight,
length and capacity (मानं दूलादुत्तमैः).

The *Krishnala* (*Gūñja*, *Raktikā*, the black and
red berry of the Shrub *Abrus Precatorius*) was
employed as a natural measure of weight. 80
Krishnala berries on the average weigh 105 grains
Troy, and this must be taken as the basis of our
computation, though in current practice 80 *Krish-*
nalas are taken to be equivalent to 210 grains.
One *Krishnala* was supposed to weigh as much as
3 medium-sized barley seeds (मसूर), one of
the latter as much as 6 white mustard seeds
(शेरसूत), one white mustard as much as 3 *Rāji*
mustard seeds (रजिसूत), one of these seeds as much
as 3 *Likshas*, and one *Liksha* as much as 5 *Rajas*
or *Trasarekus*.

We now come to conventional measures. One
gold *Māśā* was the weight of 5 *Krishnalas* of
gold, 1 *Suvarṇa* or *Tolā* weighed as much as 16
Māśās, and one *Pala* as much as 4 *Suvarṇas* or
Tolās. A *Pala* of gold therefore weighs 320 *Krish-*
nalas (Manu, Chap. VIII, Vishnu, Chap. IV, and
Yājñavalkya, Chap. 1).

A Masha of gold therefore would weigh $6\frac{1}{4}$ grains; a Tola, 105 grains (in current practice it weighs nearly double as I have stated); and a Pala, 420 grains Troy.

The measures for silver were the following:—
 1 Silver Masha = 2 Krishnalas, 1 Dharana = 16 Silver Mashas and 1 Pala = 10 Dharanas. A Pala of silver would therefore weigh 320 Krishnalas. In other words, the Pala was a fixed measure of weight, and was equal to about 420 grains Troy, or double this, if we take the Krishnala of current practice.

A Pala, which equals 320 Krishnalas, was subdivided by 4, 16 and 5 successively for gold, and by 10, 16 and 2 successively for silver. A Suvarna (or Tola) of gold corresponds roughly to a Dharana of silver, and a gold Masha to a silver Masha, but the sizes (or volumes) are not the same, and we must not therefore conclude that gold was supposed to be heavier than silver in the proportion of 5 to 2.

We find that 1296 Trasarenu equal 1 Krishnala. A Trasarenu, as a measure of weight, therefore, is the equivalent of $\frac{1}{1296}$ of a grain Troy or double this according to current measures.

But the Trasarenu of physics is a different conception. It stands for the *minimum visible*, i.e., as the physicists define it, that which is *just discernible* as a glancing particle in the slan-

ting beams of the morning (or afternoon) sun, coming into dark room through a chink or orifice of a window. This is a measure of size (or rather stimulus limen).

Measures of Capacity. Here the standard was furnished by the Kudava (कुदावा), a vessel described as 3 Angulis long, 3 Angulis broad, and $1\frac{1}{2}$ Anguli deep,—with a cubical capacity of $13\frac{1}{2}$ cubical Angulis. 4 Kudavas=1 Prastha, 4 Prasthas=1 Adhaka, 4 Adhakas=1 Drona, and 4 dronas=1 Khāri or Bhāra.

24 Angulis make 1 Hasta, cubit, which may be taken to be 18 or 19 inches. A Kudava was divided into 4 Palas, and there can be no doubt that originally water of the weight of 4 Palas was found to be actually contained in a vessel of the cubical capacity of a Kudava. If we take the ancient cubit to have been 19 inches, the Kudava would contain nearly 4 Palas of distilled water at 30 Centigrade. On a cubit of 18 inches, the Kudava would contain about $3\frac{1}{2}$ Palas.

The Kudava in current medical practice is supposed to represent a cubical vessel, each side being 4 Angulis. This would give a capacity of 27 cubic inches, if we take the modern cubit of 18 inches. The Kavirājas take a Kudava to contain 8 Palas of water, and as 1 Pala=320 Krishnālas, and 80 Krishnālas are now taken to be equal to 210 grains Troy, a vessel of a capacity

of 27 cubic inches is accordingly supposed to contain about 6720 grains Troy,—which is not very wide of the mark, being about 1·3 per cent short for distilled water at 86° Fahrenheit or 30° centigrade.

Size of the *minimum visibile* ; size of an atom.

The supposed thickness of the just discernible mote in the sunbeam called a Paramānu in Technology, S'ilpa-sāstra, (and a Trasarenu in Natural Philosophy, follows directly from Varāhamihira's table :—8 Paramānus make 1 Rajas (or Ratharenu,—cp. the Mānasāra), 8 Rajas make 1 Bālāgra (filament of hair), 8 Bālāgras make 1 Likshā, 8 Likshās make 1 Yūkā, 8 Yūkās make 1 Yava, 8 Yavas (the Mānasāra has 4) make 1 Anguli (superior), 24 Angulis make 1 Hasta (cubit, lesser cubit, 18 inches). The thickness of the *minimum visibile* (the finest perceptible mote in the slanting sunbeam) is therefore taken to be 3.2^{-10} or $32\frac{1}{128}$ of an inch. The volume of a spherical Trasarenu (or Paramānu of the S'ilpa-sastra) would therefore be $\frac{4}{3} \pi 3.2^{-30}$ of a cubic inch. It may be here noted that such a Trasarenu is supposed in the medical schools to contain 30 chemical atoms (Paramanus of Natural Philosophy) according to one estimate, or 60 according to another. The size of an atom must then have been conceived to be less than $\pi 3.5^{-1} \cdot 2^{-30}$ of a cubic inch.

परमाण्वकीवालावहिकदूकं दवीद्रुलं अति चटुगुणि दवीनरु च

मेकं भवति संख्या—Varāhamihira, *Vrihatsamhitā*, chap. 57, Śloka 2—जात्याकारगते भासो यद्वक्तुं द्रव्यं रज्जो गति तद्विधात् परमाणुं प्रथमं तद्वि प्रमाणात्तम् । *ibid.*, Śloka I,—Cf. Upala, तत्परमाणुं नाम प्रमाणं जानीयात् । प्रमाणात् सर्वेषां तत् प्रथममाद्यं प्रमाणं परमाणुर्ह्ययम् । Cf. also, तद्विधात् विधेयः (संख्या परमाणुभिः) ।

The magnitude of a Paramānu is called *Parimāṇdālya* (परिमाणदाल्य) in the *Nyāya-Vaisesika*, the name suggesting that the Paramānus were conceived to be spherical in shape. The *Nyāya-Vaisesika* calls a Paramānu a mere point without any dimensions, but in the *Sāṅkhya-Pātañjala*, a Paramānu, though indefinitely small, had still dimensions, being divisible into *Tanmātras*, which were themselves integrations of *Bhūtādi*. The diameter of a spherical Paramānu must have been conceived to be less than $3 \cdot 2^{-10}$ of an inch (i.e. less than the conventional Paramānu with which linear measures begin), and the volume of a Paramānu would therefore, in accordance with Bhāskara's formula, be smaller than $\frac{4}{3} \pi 3^3 \cdot 2^{-30}$ or $\pi 3^2 \cdot 2^{-11}$ of a cubic inch where $\pi = \frac{22}{7} \frac{17}{12}$. The *Tanmātras* were conceived as smaller still.

That these were conventional measures arbitrarily assumed goes without question, for, of course, the Hindus had no physical data for a mathematical calculation of these minute quantities. A *Balāgra* (hair-tip, or finest filament of hair), for example, is taken to be $3 \cdot 2^{-11}$ of an inch

thick, i.e. less than one five-thousandth fraction of an inch in thickness; and a fibril of the networks of Dhamanī or Nādi (nerve) that supply the pores of the skin (papillæ ? मुसुनानि रीमद्वपनिस्रवणानि, Susruta) was supposed to be about a thousandth part of the finest hair in thickness, or $\frac{1}{1000}$ of the 'minimum visible', and therefore about $3 \cdot 10^{-12}$ of an inch thick (cf. इच्छनादीन्धारतः रीमः सप्तशतशतैर्न तुल्यान्तु मन्वरेति, Pañchadasi), but it is evident that these measures were arbitrarily fixed upon, instead of being arrived at by calculation or actual measurement. Indeed, Charaka expressly states that the number of Sīrās and Dhamanīs in the body (three million fifty-six thousand nine hundred) is only a conjectural estimate अनिर्दिष्टतः परं वर्तमानं—Sūtrasthāna, Chap. VII).

My account of the chemistry of the Sāṅkhya-Pātañjala, and of the affiliated Yoga and medical schools, has anticipated in several points the views of the Vedānta and the Nyāya-Vaiśeṣika. The chemical facts, processes and apparatus are indeed common to all the schools. In the following account of the chemistry of the schools other than the Sāṅkhya-Pātañjala, I will confine myself to the theory of the subject, and even of this I will attempt only the briefest outline.

The Vedāntic view :—

The Vedāntists believe Māyā to be the 'material cause' (उपादानकारण) of the world. The power

of Māyā is the power to realise the unreal—to impart practical Reality or mediate existence to that which does not and cannot possess absolute Reality or self-existence. Māyā is at once real and unreal, while the Brahma (Self) is absolute Reality, absolute Intelligence and absolute Bliss. The world evolves out of Māyā (मायावर्तिता) so that Māyā in the Vedānta replaces the Prakṛiti of the Sāṅkhya. But Māyā, and by implication the world, originate out of Brahma, not by a process of evolution (वर्तिता), but of Vivarta (self-alienation). The self-alienation of the Absolute, acting through Māyā, produces in the beginning Ākāśa, one, infinite, ubiquitous, imponderable, inert and all pervasive. The world thus begun goes on evolving, in increasing complexity. The other Sūkṣma Bhūtas, classes of subtile matter, evolve from Ākāśa, in an ascending linear order,—Ākāśa giving off Vāyu, Vāyu giving off Tejas, Tejas giving off Ap, and Ap giving off Earth. Ākāśa, one, infinite, all-pervasive, has the capacity of sound. Vāyu, subtile gaseous matter, emanates from the universal Ākāśa and is instinct with the potential of mechanical energy (impact, pressure). ईश, इन्द्राग्नि, वरुण, अरुण,—आसीत् सर्व-वेदादिभूतम् । सर्वविद्याभूतत्वात्—Vidvanmanorajīni). Tejas, subtile radiant matter, emanates from Vāyu, and contains in potentia the energy of light and heat. Ap, subtile viscous matter, is the

transformation of Tejas, and is instinct with the energy that stimulates the nerve of taste, and lastly, Earth, subtile hard matter, which is the transformation of Ap, possesses the latent energy of smell.

But the subtile rudiments of matter must be compounded in various ways, to give rise to the gross constituent matter of the world. These forms of gross matter are called Mahābhūtas. There are five kinds of Mahābhūta (gross matter corresponding to the five Sūkshma Bhūtas (subtile matter, and the process by which a Mahābhūta is produced from the Sūkshma Bhūtas is called Pañchikarava (quintuplication). All the five Sūkshma Bhūtas are present as ingredients, though in different proportions, in each Mahābhūta.

The Mahābhūta Earth, gross earth-matter, is composed of four parts of subtile earth-matter, and one part each of the other forms of subtile matter. The Mahābhūta Vāyu is composed of four parts of subtile gaseous matter and one part each of the other forms of subtile matter. And similarly with other Mahābhūtas.

Hence if *ak*, *v*, *t*, *ap*, *e*, represent the five forms of subtile matter (Akāśa, Vāyu, Tejas, Ap and Earth), and *Ak*, *V*, *T*, *AP*, *E*, stand for the corresponding Mahābhūtas, we may represent the constitution of the Mahābhūtas as follows :—

$AK = ak_4, (v_1, t_1, ap_1, e_1), ak_4$ being the radicle.

$V = v_4, (ak_1, t_1, ap_1, e_1), v_4$ being the radicle.

$T = t_4, (ak_1, v_1, ap_1, e_1), t_4$ being the radicle.

$AP = ap_4, (ak_1, v_1, t_1, e_1), ap_4$ being the radicle.

$E = e_4, (ak_1, v_1, t_1, ap_1), e_4$ being the radicle.

In forms of gross or compounded matter, the potential energies (or qualities) become actualised. The Mahābhūta Akāsa manifests sound; Vāyu, sound and mechanical energy; Tejas, sound, mechanical energy and heat-light; Ap, the energy of the taste-stimulus in addition; and finally Earth the energy of the smell-stimulus added to the foregoing.

The Pañchadasi characterises the different Mahābhūtas by their typical sounds; e.g., Akāsa by the echo (hollow booming sound); Vāyu (air) by a sibilant sound, hissing, susurration (imitative symbol, Visi); Tejas (fire) by a puffing (or roaring) sound (imitative symbol, Bhugubhuga); Ap (water) by a liquid sound (imitative symbol Culu Culu, gurgle, splash-splash, glut-glut); and finally Earth by a splitting or rattling sound, a crack or a thud (symbol, kad-kada)—Chap. II. Bhūtavivaka, Śloka 3, Pañchadasi, cf. also Jayanta, Mañjari.)

Others hold that Akāsa, Ether, never enters as a component part, and is always one and indivisible. In this view, the four Mahābhūtas—Vāyu, Tejas, Ap and Earth alone are supposed to be com-

pounded, and by a process which may be called quaternion (cf. the Neo-Platonist quaternion) :—

$$V = v_2 (t_1, ap_1, e_1)$$

$$T = t_2 (v_1, ap_1, e_1)$$

$$AP = ap_2 (v_1, t_1, e_1)$$

$$E = e_2 (v_1, t_1, ap_1)$$

These compound forms, as before, are supposed to exercise their specific energies actively. Others again hold that the Mahabhūtas—Tejas, Ap and Earth alone are compounded by a process named Trivrit-karana (triplication). Thus $T = t_2 (ap_1, e_1)$, $AP = ap_2 (t_1, e_1)$, $E = e_2 (t_1, ap_1)$.

The Sūkshma-bhūtas are forms of homogeneous and continuous matter, without any atomicity of structure; the Mahabhūtas are composite; but even these are regarded as continuous, and without any atomic structure. The Vedānta speaks of Anu (Paramānu) not as an ultimate indivisible discrete constituent of matter, but as the smallest conceivable quantum or measure of matter. In the Sāṅkhya doctrine, the atomic structure is ordinarily accepted. The Guṇas are supposed to be अविनाश and अमर bounded and indefinitely small in size (except the Guṇas giving rise to A'kāśa and Manas which are unlimited अक्षय); and hence the Tanmātras and Paramānus must be conceived to have a discrete structure.

As I have already noted in my account of the genesis of Tanmātras and Paramānus, various

schools of Vedāntists (e.g. the Rāmānujists and the followers of Nimbārka) combined, in the orthodox fashion of the Smṛitis and the Purāṇas, the Vedāntic theosophy with the Sāṅkhya cosmology especially as regards Prakṛiti and the order of creation and dissolution. For example, the Vedānta-kaustubhaprabhā, fortifying itself with texts from the Vishnu Purāṇa and the Subala and Gopāla Upanishadas, contends that at the cosmic dissolution (Pralaya), each Mahābhūta merges into the one that preceded it in the order of creation by first disintegrating into its own proper Tanmātric form (अवस्था), and that the Mahābhūta Akāśa merges into the original Tanmātras, which then lapse into Bhūtādi, the supersubtile rudiment matter, proto-matter (Chap. II, Pada 3 Sutra 14).

Parināma—Evolutionary Process:—When the Mahābhūtas are once formed, the different kinds of substance are derived from them by the evolutionary process called Parināma (परिवर्तन, transformation). Matter is constantly undergoing change of state. The effect is only the cause in a new collocation (कारणस्यैव संज्ञानमानं कार्यम्). Change is of two kinds :—

(1) Change by a spontaneous process, without external influence, including isomeric change (आन्तरिक परिवर्तन). The Vedāntists believe in

spontaneous disintegration and reintegration. Action from without, impressed force *ab extra*, is not, pace the Naiyáyikas, always a condition of change of state (whether of rest or of motion);—nor is it necessary that more than one substance should combine to generate another substance or variety of substance (e. g. the formation of curds from milk, of ice from water etc.). All this is directed against the Nyāya doctrine (A'rambhavāda).

(2) Change due to combination with other substances (द्वयानुसंयोग). Such combination may produce (1) a compound substance possessing like qualities with the constituents (समानजातीयोत्पत्ति), or (2) unlike compounds with new qualities, "heteropathic effects" (विजातीयोत्पत्ति). Any new quality thus evolved through (chemical) combination is called *Sambhata-bhūta-dharma* (संभूतवृत्तवर्ग), e. g. the intoxicating power of the fermented rice and molasses, which does not exist in the ingredients taken separately. (संघटीकानां प्रत्येकं अपरस्मान्नापि समुदायवृत्त्या नदमति: इत्यने). This *Sambhūyakriyā* (संभूयक्रिया, समुत्पत्ति) corresponds to chemical combination, and the Vedantists, like the Sāṅkhyas, explain this only as the evolution of the latent energy (शक्ति, अमुद्भूतशक्ति) in a new collocation (संस्थापन, अवयव-संघटीक). But, unlike the mediæval Sāṅkhyas, the Vedānta freely recognises the com-

bination of heterogeneous Bhūtas. Thus, Earth, Ap, Tejas and Vāyu freely combine in different proportions and groupings to produce the variety of substances in the world. For example, the animal organism is a compound of all the five Bhūtas (पञ्च-भौतिक). It is not merely the concomitant or efficient causes that may be heterogeneous to the material cause, as the Naiyāyikas contend, but several heterogeneous substances or (Bhūtas) may unite as 'material causes' to produce a new substance.

The Vedantists resolve all activity, physical, vital as well as psychical, into modes of motion, subtle cosmic motion (परिस्फन्द, सर्वलोकपरिस्फन्द—S'āṅkara ; वाचोः परिस्फन्दोऽसकलात्,—प्राचस्य परिस्फन्दोऽसकलादेव—यद्व नं स्फुल्लं दृष्टं च तदालम्बं मनःस्फन्दितमावम्—S'āṅkara); but they give a separate substantive existence to the agents, the vital principle (प्राण) and the mind (मनः), though these are also evolutionary transformations of the Sūkshma Bhūtas (forms of subtle matter). What is common to the Nyāya, the Vedānta and the Sāṅkhya is that Consciousness or Intelligence (चैतन्य) transcends Matter; but the Naiyāyikas as pluralists hold that vital and psychical activities are also immaterial and cannot be resolved into motion (परिस्फन्द);—the Vedāntists resolve these activities into subtle motion, but

ascribe them to a substantive quasi-material Life Principle and Mind, the all-mirroring Intelligence (चेतसः) alone being immaterial and transcendent: and the Sāṅkhyas accept the substantive existence of the Mind principle (मनः) as derived co-ordinately with the Sūkṣhma Bhūtas or Tanmātras from individualised prakṛiti (Ahankāra), but resolve Life into a mere resultant activity of the bodily organs, viz. the organs of sense and movement, and the psychic principle (मनः).

पञ्चीकरणः—विधा विधाय चैकैकं चतुर्धा प्रथमं पुनः ।

सर्वोत्तरदितीयाधैर्धीजानां पञ्च पञ्च ते ।

यथा विसर्गयुतौ सहासा भूतानां स्फुटतरस्यवकारणः सङ्घस्य करस्यो-
पायतया विभक्त्यर्थं युतं तदन् भूतपञ्चकसर्गयुतौ अपि तथा । तदानीं
पञ्चीकरणान्तरं आकाश स्रष्टीऽभिव्यज्यते स्फुटतयेति सर्वत्र योजनीयं
(विद्वन्मनीषिणी)—अस्ति हि शरीरे सर्वेष्वङ्गेषु भूतानां कार्य-
संघतिपतिः अवकाशानुद्भूतपवनज्ञेदनकादिनाम सर्वजनानुभवसिद्धत्वात् ।
अतस्तत्कारणतया पञ्चानि भूतानि एकस्मिन् देहे सन्तीति स्मृते
तन्नुपपत्तीरिव अवयवावयवित्वमेव पञ्चभूतदेहघोर्भूतं । न च स्वार्थशून्यत्वात्
एकद्रव्यत्वात् च आकाशस्य आरम्भकत्वाद्युपपत्तिरिति वाच्यं । आरम्भ-
वादस्य अनङ्गीकारात् । एकत्वापि दुष्प्रवयविनी दम्भारम्भकत्वदर्शनात् ।
स्फुटतया पञ्चानां भूतानां पञ्चात्मकत्वस्य दर्शितत्वात् आरम्भवादस्य
निरासकत्वात् च । तस्मात् सिद्धं शरीरं पाञ्चभौतिकमिति । Vidvan-
manorajjina.

न तावत् समानजातीयमेव आरभते न भिन्नजातीयमिति विधमो
 नाति । समवायिकारश्च एव समानजातीयत्वाभ्युपगमात् न कारवान्तर-
 विषय इति तदपि अनेकान्विकम् । नापि अनेकमेव आरभते नैकमिति
 नियमोऽस्ति । अष्टमलसौराद्यकचौराभ्युपगमात् । एकेऽपी हि परमाह-
 वायं सप्तम्यारभते न द्रव्यान्तरैः संदृष्टं द्रव्यभ्युपगमते । द्रव्यान्तरं एव
 अनेकारम्भजननियम इति चेत् न परिणामाभ्युपगमात् । तदेव तु
 द्रव्यं विमेषवदवस्थानरं अपेक्षमानं जायते नामाभ्युपगमते । तत्र कश्चित्
 अनेकं परिचयते स्रक्कीकादुरादिभावेन, कश्चिदेकं परिचयते सौरादि-
 द्रव्यादिभावेन । नैश्वर्यासनं अस्ति अनेकं एव कारणं जायते जनयति
 इति । Śāṅkara, Śāriraka bhāṣhya, Sūtra 7, Pada 3,
 Adhyāya II).

The atomic theory of the Buddhists :—The
 Vaibhāṣhikas and the Sautrāntikas held that the
 Vāyu-atoms are touch-sensibles, having impact or
 pressure for their characteristic property, and
 by aggregation from the element Vāyu; the
 Tejas-atoms are colour-and-touch-sensibles, having
 heat for their characteristic, and by aggre-
 gation from the Tejas Bhūta; the Ap-atoms are
 taste-colour-and-touch-sensibles with a characteris-
 tic viscosity, and form the Ap-element by aggre-
 gation; and finally the Earth-atoms are smell-taste-
 colour-and touch sensibles possessing a character-
 istic dryness or roughness (खरत्वं), and by their
 aggregation form the Earth-element. The Bhūtas

thus originated combine to form aggregates, which are classed as inorganic substances, organisms and organs. (कामेऽष्टद्वन्द्वकीदृशः—Udyotakara's extract from the Buddhist Sūtras, Nyāya Vārtika. Chap. I. A'hnikā 1, Sūtra, 14, cf. Vāchaspati's fuller extract :—कामे षष्टद्वन्द्वकीदृशरजस्तः रूपधातुरक्षयधातुः कामधातुः—also the Buddhist commentary :—कामे कामधातौ षष्टद्वन्द्वकः षष्टः । रूपरजस्तमक्षयधातौ इति षड्वारि द्वन्द्वानि इविष्यन्तीतीत्युः इति षड्वारि—Vāchaspati. Tātparyyaśikā, loc. cit.—also क्षरक्षेदोच्चैरपक्षमावनि भूतानि—*vide* Udyotakara, Chap. III, A'hnikā 2, Sūtra 12,—*Vide* also Śrīnivāsa's Vedānta-kaustubha, Chap. II, Pada 2. Sūtra 18).

The atomic theory of the Jainas :—Of the nine categories of the Jainas, that of Ajīva (the not-soul or non-Ego) consists of five entities, four of which are immaterial (अमूर्त), viz., merit, demerit, space and Time, and the fifth, material (मूर्त, possessing figure). The last is called Pudgala (matter), and this alone is the vehicle of Energy, which is essentially kinetic, i.e. of the nature of motion. Everything in the world of not-soul (the non-Ego) is either an entity (द्रव्य), or a change of state in an entity (पक्षावयव). Pudgala (matter) and its changes of state (पक्षावयव), whether of the nature of subtile motion (परिव्यवस्थान्तर) or of Evolution (परिवर्तन), must furnish the *physical* as opposed to the *metaphysical* basis of all our explanations of Nature. Pud-

gala (Matter) exists in two forms,—Anu (atom) and Skandha (aggregate). The Jainas begin with an absolutely homogeneous mass of Pudgalas, which, by differentiation (भेद) breaks up into several kinds of atoms qualitatively determined, and by differentiation, integration, and differentiation in the integrated (संवातात्, भेदात्, संवातभेदात्—Umāsvāti, Chap. V, Sūtra 26), forms aggregates (Skandhas). An Anu has no parts, no beginning, middle or end. An Anu is not only infinitesimal, but also eternal and ultimate. A Skandha may vary from a binary aggregate (द्वयम्) to an infinitum (अनन्तद्वयम्). A binary Skandha is an aggregate of two Anus (atoms), a tertiary Skandha is formed by the addition of an atom (Anu) to the binary (द्वयम्) and so on *ad infinitum*. The ascending grades are (1) what can be numbered (संख्येय), (2) indefinitely large (असंख्येय), (3) infinity of the first order (अनन्त), (4) infinity of the second order (अनन्तानन्त), and so on.

General Properties of Matter :—

The specific characters of the Pudgalas (Matter) are of two kinds, (1) those which are found in atoms as well as in aggregates, and (2) those which are found only in aggregates. Qualities of touch, taste, smell and colour come under the first head.

The original Pudgalas being homogeneous and indeterminate, all sensible qualities, including the infra-sensible qualities of atoms, are the result of evolution (वर्णन). Every atom thus evolved possesses an infra-sensible (or potential) taste, smell and colour, (one kind of each) and two infra-sensible tactile qualities, e.g. a certain degree of roughness or smoothness (or dryness and moistness ?) and of heat or cold. Earth-atoms, Ap-atoms, etc. are but differentiations of the originally homogeneous Pudgalas. The tactile qualities (स्पर्श, त्वक्, सूक्ष्म, मोक्ष) appear first, but qualities of taste, smell and colour are involved in the possession of tactile qualities. An aggregate (Skandha), whether binary, tertiary or of a higher order, possesses (in addition to touch, taste, smell, and colour) the following physical characters :—(1) sound, (2) atomic linking, or mutual attraction and repulsion of atoms, (3) dimension, small or great, (4) figure, (5) divisibility, (6) opacity and casting of shadows, and (7) radiant heat and light.

Sensible qualities. Tactile qualities are of the following kinds—hardness or softness, heaviness or lightness (degrees of pressure), heat or cold, and roughness or smoothness (or dryness and viscosity ?). Of these, the atoms (Atmas) possess only temperature, and degrees of roughness or smoothness, but

all the four kinds of tactile qualities in different degrees and combinations characterise aggregates of matter from the binary molecule upwards. The Jainas appear to have thought that gravity was developed in molecules as the result of atomic linking. Simple tastes are of five kinds,—bitter, pungent, astringent, acid and sweet. Salt is supposed by some to be resolvable into sweet, while others consider it as a compound taste. Smells are either pleasant or unpleasant. Mallishena notes some elementary varieties of unpleasant smell, e.g. the smell of asafetida, ordure, etc. The simple colours are five—black, blue, red, yellow and white. Sounds may be classed as loud or faint, bass (thick) or treble (hollow), clang or articulate speech.

The most remarkable contribution of the Jainas to the atomic theory relates to their analysis of atomic linking, or the mutual attraction (or repulsion) of atoms, in the formation of molecules. The question is raised in Umāsvatī's *Jaina Sūtras* (circa A. D. 40)—what constitutes atomic linking? Is mere contact (or juxtaposition) of atoms sufficient to cause linking? No distinction is here made between the forces that bind together atoms of the same *Bhūta*, and the chemical affinity of one *Bhūta* to another. The Jainas hold that the different classes of elementary substances (*Bhūtas*) are all evolved from the same primordial atoms.

The intra-atomic forces which lead to the formation of chemical compounds do not therefore differ in kind from those that explain the original linking of atoms to form molecules.

Mere juxtaposition (समीप) is insufficient; *linking* of atoms or molecules must follow before a compound can be produced. The linking takes place under different conditions. Ordinarily speaking, one particle of matter (द्रव्य) must be negative, and other positive (सिद्धात्पुत्र); the two particles must have two peculiar opposite qualities, roughness and smoothness (खल and सखल or dryness and viscosity?), to make the linking possible. But no linking takes place, where the qualities, though opposed, are very defective or feeble (अव्यक्त). We have seen that, ordinarily speaking, two homogeneous particles, i.e. both positive, or both negative, do not unite. This is the case where the opposed qualities are equal in intensity. But if the strength or intensity of the one is twice as great as that of the other, or exceeds that proportion, then even similar particles may be attracted towards each other. In every case, change of state in both the particles is supposed to be the result of this linking, and the physical characters of the aggregate depend on the nature of this linking. When particles of equal intensity (negative and positive) modify each

other, there is mutual action ; in cases of unequal intensity, the higher intensity transforms the lower, it being apparently thought that an influence proceeds from the higher to the lower. All changes in the qualities of atoms depend on this linking. A crude anticipation this, of the ionic theory of chemical combinations, very crude but immensely suggestive, and possibly based on the observed electrification of smooth and rough surfaces as the result of rubbing. The interpretation of द्रव and द्रिक् as dry and viscous (or as vitreous and resinous ?) must be rejected in this connection as untenable. The Tattvārthādhigama of Ūmāsvatī, which expounds the theory, most probably dates back to the first half of the first century A. D. Cf. Ūmāsvatī—Tattvādhigama, Chap. V.

(अजीवकाया दध्नाधनोकाग्रदुहलाः । उज्ज्वलि जीवाश्च । निता-
नक्षितानि अक्षपाणि । रुपिणः पुद्गलाः । आकाशादीनद्वयाणि ।
निक्षिप्याणि च । पुद्गलजीवास्तु क्रियावन्तः । (क्रियेति गतिकर्माश्च) ।
सर्व्वेर्वा इदंज्ञाः सन्ति अन्धश्च परमाधीः । सर्व्वोपाहंस्योवाश्च पुद्गलानां ।
नाधीः । सार्ग्वरसंगत्यवर्णवन्तः पुद्गलकाः । सप्त अक्षोष्टद्विधः कठिनी
सदुर्गुरुर्लघुः शीतः स्रग्गः क्षिण्यः द्रव्य इति । रसः पञ्चविधक्षिणः
कटुः खवाघ्नीः श्लो मधुर इति । गन्धी द्विविधः सुरमिरसुरमिश्च । वर्षः
पञ्चविधः कृष्णो नीलो लोहितः पीतः श्वेत इति ।

अद्भवन्मयीः प्राण्योऽप्यहंस्यानभेदतन्मन्त्रायातपीयोतद्वन्तः । तत्र द्रव्यः
चक्षुर्विधः ततो विततो जगः शुश्रिरो वर्षो मास इति । अन्धः

काम्याय । उक्तं च । कारकमेव तदन्तः सूक्ष्मी निरूप्य भवति परमायुः ।
 यकारकमन्वयार्थं दिव्यार्थः कार्यनिष्ठश्च । तत्रादधीनताः काम्यायु मन्त्रा
 एव । काम्यायान् संघातमेदीयं उक्तमयान् । संघातमेदादिति । इदोः
 परमायुः संघाताद्विप्रदीयः । दिव्येदीयस्यांशोऽयं संघातान् विप्रदीयः ।
 एवं संख्येयान्तरसंख्येयानामनन्तानां अनन्तानन्तानां च प्रदीयानां
 संघातान् प्रदीयाः । मेदादयः । मेदादेव परमायुर्दृश्यवती न
 संघातादिति । अत्राह । किं रंघीयमात्रादेव संघाती भवति ।
 आहोस्मिदिति कथिद्विविधं इति । अतोऽप्यने । सति रंघीनि बहुलं
 संघाती भवतीति । शिरषवृत्तादयः । न कथमगुणानाम् । कुन्त-
 दययोः पुद्गलयोः पादयोर्बन्धो भवतीति । लघ्वगुणस्त्रिगुणानां
 लघ्वगुणश्चत्वार्यां च परस्परं रन्धो न भवतीति । उक्तं भवता
 लघ्वगुणश्चत्वार्यां त्रिगुणानां रन्धेन द्वायायां च त्रिगुणेन सप्त रन्धो
 भवतीति । अथ गुणगुणयोः किमत्यन्तमिति चेत् इति । अतोऽप्यने ।
 न । गुणसाम्यं सहमानां । गुणसाम्ये सति सहमानां रन्धो न भवति ।
 नदृश्या । गुणगुणस्त्रिगुणस्य गुणगुणस्त्रिगुणेन गुणगुणश्चत्वार्यां
 रन्धेन इति । अत्राह सहस्रयद्दत्तं किमपेक्षते इति । अतोऽप्यने ।
 गुणबैषम्ये सहमानां रन्धो भवति इति । अत्राह किमतिशयेन गुण-
 नैषम्ये सहमानां रन्धो भवतीति । अतोऽप्यने । बाधिकादिगुणानां
 तु बाधिकादिगुणानां सहमानां रन्धो भवति । त्रिगुणाद्यधिकस्त्रिगुणेन ।
 त्रिगुणाद्यधिकस्त्रिगुणा स्त्रिगुणेन । कथस्यापि त्रिगुणाद्यधिकश्चत्वार्यां
 रन्धेन । एकादिगुणाधिकयोस्तु सहस्रगीर्बन्धो न भवति । अत्राह
 परमायुश्च सन्नेषु च द्वे अर्थादयो गुणास्ते किं व्यवस्थिताः तेषु

वाचोविदमवस्थिता इति । अनीक्यते । अन्यवक्षिमाहुतः । परिचामात् । अमाह इयोरपि मध्यमानयोर्मुच्यमाने सति कथं परिचामी भवति इति । उच्यते । अन्ते समाधिकौ पारिचामिकौ । अन्ते सति समनुकूल समनुवः परिचामिकौ भवति । अधिकानुवो हीनस्तेति । *Umāsvatī, Tattvārthābhigama, Chap. V.*

The Nyāya-Vaiśeṣika chemical theory : a brief summary.

I must content myself here with a brief and rapid sketch of the chemistry of the Nyāya-Vaiśeṣika, which I shall elaborate in connection with the mechanics and physics of the ancient Hindus in a separate paper.

The relation of the specific characters of molecules (and higher aggregates) to the original atomic qualities is reduced in the Nyāya-Vaiśeṣika to the following canons :— (a) कार्यगुणं कारकगुण-पृथगेकम् । (b) समानजातीयसंयोगः द्व्यारण्यकः न विजातीयसंयोगः । (Here, *द्वय* is used in a narrow technical sense, so as to exclude the quasi-compound sub-stances). (c) क्वाकलकपरसदभ्यस्यैवपरिमाणैकलैकवृत्तानुदलद्वयस्यैकवृत्तिः कारकगुणगुणैकः । (d) क्वाकलकभानुव्यस्यैवपरिमाणैकलैकवृत्तानुदलः समानजात्यारण्यकः । No separate explanation is necessary, as the canons are embodied in the following exposition.

Theory of Atomic combination :—

The four kinds of Atoms are Earth, Ap, Tejas and Vāyu atoms, possessed of characteristic mass, numerical unit, weight, fluidity (or its opposite), viscosity (or its opposite), velocity (or quantity of impressed motion—Vega) ; also characteristic potential colour, taste, smell or touch, not produced by the chemical operation of heat (अग्नौ वायु-अपरमाण्वस्यार्थपरिमाण्वेकत्वं क-पदक-गुणलक्षणैश्चवेगः), A'kāśa has no atomic structure (निरवयव), and is absolutely inert (निष्क्रिय), being posited only as the substratum of sound, which is supposed to travel wave-like in the manifesting medium or vehicle of Vāyu (air). Only the other four Bhūtas unite (or disunite) in atomic or molecular forms. The orthodox view is that, the presence of Earth-atoms is necessary whenever chemical transformation under the operation of heat (वाक्योद्घर्ष) takes place.

Atoms cannot exist in an uncombined state in Creation (Sivādityā, Sapta-padārthi—*Vide* commentary, where, however, it is noted that still atmospheric air is believed to be monatomic in structure, i. e. to consist of masses of atoms in a loose uncombined state—(सिद्धिस्तथाप्युक्तं परमाण्वसमूह एव अनादय-द्रव्यः)

The atoms may combine in one or other of the following ways :—

1. One Earth-atom, by an original tendency, unites with another, to form a binary molecule (द्वन्द्व). In the same way, binary molecules of the other Bhūtas are formed. The atoms are possessed of an inherent Parispanda (rotary or vibratory motion), and when they unite in pairs, so long as there is no chemical operation under the action of heat corpuscles, the original qualities of the atoms produce homogeneous qualities in the binary molecules.

The question as to the existence of a triad, a tetrad, a pentad etc. of atoms is one of the moot points of the Nyāya-Vaiśeṣika. The orthodox view is that, the primordial infinitesimal particles (atoms) start with an incessant vibratory motion चतुर्दशदिशि गच्छन्ति वा वायुः पश्चिमदिशि गच्छन्ति वा अग्निः, Raghunātha Siro-mani—नतिस्तीक्ष्णत्वात् पतनस्य पदेष्टाः पतन्तीनि, Udayana, Kusu-māñjali), and an inherent impulse that drives them to unite in pairs—a sort of 'monovalency', as it were, exhausted with the formation of a binary molecule. The binary molecules now combine by threes, fours, fives, etc. to form larger aggregates as well as the variety of elementary substances, the particular collocation in any case being not only determined by physical causes, but also serving to satisfy the ends of the moral Law in creation (चतुष्टयं, जगत्), (वायुर्जलं पृथिवीरश्मि इत्यपि त्रिवर्णी.

न वाचा । अतुल्य लक्षणः । अदाचित् विविचारयते इति ।
 वाचस्पतिमुच्यते, अदाचित्प्रभिराच्यते अदाचित् पचमिरिति वरेष्टं
 कल्पना । अद्वयवशात् तथा तथा तेषां व्युत्पत्तिर्यथा यथा सदारप्येषु
 अपरजातयोः व्युत्पत्तिः । अद्वयकारिता सर्वव्यवसायां इति; (S'ridhara,
 Nyāya-Kandali, इतिवृत्तिवचनम् ।) Cf. Vāchaspati's
 report, Bhāmati, Chap. II., Pada II, Sūtra II, अदा
 अतुल्यकमारभते अतुल्यं वाचस्पतिवचनम् ।) Prasastapāda
 appears to have originated this view (परमावृत्तवृत्तेषु
 बहुलकंश्या तैराच्ये वाचस्पतिवचने—Prasastapāda, परिभाषा
 निरूपणम्); but that another view was also main-
 tained in the Vaiśeṣika School is evident from the
 brief summary of Kanāda's system given in
 Utpala's commentary on the Vāhatsambhitā, and
 this indeed also follows from S'ridhara's admissions
 in the Kandali. On this view, also, atoms have
 an inherent tendency to unite, but some unite in
 pairs, others in triads, others in tetrads, etc.
 This may happen in two ways,—either by the
 atoms falling into groups of threes, fours, etc.
 direct, or by the successive addition of one atom to
 each preceding aggregate.

A triad (Tryanuka), then, holds together three
 atoms (Anus), not three binary molecules (Dvyanu-
 kas) as on the orthodox hypothesis. Similarly with
 tetrads, pentads etc. अतुल्यः परमाणवः चित्तिलकादिवायुनाम् ।

वाचां परमाणुभां वस्तुसमावेशेति विभिः परमाणुभिस्त्रायकमारभते इति
 लक्षितं सूत्रकार्य-द्रव्यस्रोत्पत्तिः । Utpala, Chap. 1. S'loka 7 ;
 cf. also S'ridhara's admission, अथवा यदि परमाणवो वास्तु-
 सारभ्यं तत्कद्वितास्त्रायकमारभन्ते वास्तुवस्तुविज्ञास्तु इत्यान्तरम् तदापि कुतो
 विज्ञेयं अथवद्वयम्). S'ankara seems to speak of two binary
 molecules in the Vaiseshika as forming a tetrad,
 (तदापि हे वास्तुके चतुरवस्तुमारभन्ते—S'ankara-Bhāshya, Chap.
 II, Pada Sūtra, II, where the Bhāmuntī gives a forced
 interpretation).

In Prasastapāda's view, these binary molecules
 are grouped by threes, fours, fives *etc.* (त्रायक, चतुरवस्तु)
 to form different isomeric modifications. The variety
 of Earth-substances is due to differences in the
 arrangements of the molecules. (*e.g.* their greater or
 less density, and, above all, their grouping or collo-
 cation व्यूह, अवयवसंनिवेश), which account for the speci-
 fic characters (अपरजाति) manifested by these iso-
 meric substances. सा इयिषी च स्वेय्यावयवसंनिवेशविभिन्नः
 अपरजातिवदुत्पत्तिरेता । Prasastapāda, इयिषीनिवदवयवम् । स्वेय्ये
 निविहलम् । आदिगम्यात् समिधिललादिपरिवहः । परमाण्वादिषु
 अपरजात्यभावेऽपि अद्वयवयवम् तथा तथा तेषां व्यूहः यथा यथा तद्वारभेयु
 अपरजातयो व्यज्यन्ते । S'ridhara, Kandalī, *ibid.*

स्वेय्ये स्तिरता चिरकाकावस्थायिलमिति वाच्यम् । आदिगम्यादिदण्डकलं
 कलादिभ्यः प्रविरोधिलक्ष्य । अवयवसंनिवेशाः तत्सत्त्वानामविशेषाभिन्नव्यव-

संज्ञानविधिषः । न हि एतद्द्रव्यान्तरं दृश्यते । जलादीनां यद्विचित्र-
 स्वरूपद्रव्यैर्नवद्रव्योपनिपातमात्रेण लक्ष्यन्ते । Udayana, Kiranā-
 vali, *ibid.* These original differences in molecular
 grouping leading to distinctions of genera and species,
 however mechanically or physically explained, come
 also under the operation of moral and metaphysical
 causes (नष्टर, नष्ट), i.e., of ideal ends in the moral
 government of the universe, which are superimposed
 upon the physical order, but which do not come
 within the scope of Natural philosophy. An elemen-
 tary substance thus produced by primary atomic com-
 bination, may, however, suffer qualitative change
 under the influence of heat (वायुनीर्षण). The pro-
 cess is as follows :—(1) the impact of heat corpuscles
 decomposes the binary (tertiary, or quaternary) mole-
 cules into homogeneous atoms possessing only the
 generic characters of the Bhūta concerned ;—(2) the
 impacts of heat particles continue, and transform the
 characters of the atoms, determining them all in
 the same way ;—(3) the heat particles continue to
 impinge, and reunite the atoms so transformed to
 form binary (or other) molecules, in different orders
 or arrangements, which account for the specific
 characters or qualities finally produced. The Vaise-
 shika holds that there is decomposition into

homogeneous atoms, transformation of atomic qualities, and finally recombination, all under the influence of heat. The Nyāya on the other hand thinks that the molecules and larger aggregates assume the new characters under the influence of heat without decomposition into homogeneous atoms, or change of atomic characters (पितृपाक or पितरपाक).

तेषामनुभावेन विनाशः परित्यजेत । सत्येवमेव अमर्षद्वय
पातपूर्वकपूर्वकपादिविशेषगुणोपलब्धेरनाशविशेषः कृतानोरनुभावे तेन
वेगवत् । परिद्वन्द्वेन नीदनात् अभिधातान् वा नूनं घटाधारणकेषु
अवधेषु क्षिप्य लाघते क्षिपातो विभागः विभागात् इत्यारम्भकसंयोग-
विनाशः । तद्विनाशान् इत्यविनाशः । पक्षात् आमादिगुणानवगन्तः
रक्षादिगुणानवगन्तमनुभवतः—अदृष्टवर्त्मनायाः परस्परं संयुज्य वायुकादि-
दकमेव तादृशमेव घटादिकार्यमारभते । एवं तदनातपदार्थमात्रेषु
आकादिकक्षेत्रेषु एव एव त्वायः शरीरे अपि सदस्येव तिलक्षणा पञ्चमाक्षेप-
अवधानादिषु रसमलधातुभावेन परिव्याप्तमुपगच्छत्सु जायेथ प्रतिअव-
सुतपादविनाशो संभवत इति । (Jayanta, Nyāyamāñjarī
सूत्रचैतन्यपूर्वपक्षः). This is the Vaisesika view, but
Jayanta himself inclines to the opposite view :—
मलतनुविरतमेव कार्येदन्त्यस्य घटादिः आरम्भात् अन्तर्लोककषातुपवेगकृत-
पातोपपत्तेः अलं विनाशकत्वमया । पितरपाकपक्ष एव वैयक्तः । *ibid.*
The Nyāya view :—ये बीजावयवास्तौ पूर्वव्युद्भवविरत्यामेव

अद्धान्तरमापयन्ते अद्धान्तरमापयन्ते च द्विविधीषातुरन्धातुना संयुक्तीर
 चाकरीक तेजसा यन्त्रमात्रो दसुद्रव्यं निर्वातं यति संस्रः पृथ्वावयवसद्विती
 ऽह्नुवादिमापयन्ते । परमात्मस्थानि योजानि भवन्तीत्येतत् प्रतिपद्यामहे ।
 यन्त्राणां आदिभोजमुद्गनायस्यामादि कला यावदुपात्ता यातिभोजकायं
 तावत् कदाचित् परमात्मवत्त्वं भवति । यदि तु स्यात् कदाचित् नोपसृज्येत ।
 Udyotakara, Chap. III, A'hnika 1, Sūtra 4.

II. Chemical combination (संयुक्तक्रिया, संज्ञकक्रिया).
 Chemical combination takes place either between
 two or more substances which are isomeric modi-
 fications of the same Bhūta, or between substances
 which are modes of different Bhūtas.

A. Mono-Bhautic compounds. The simplest
 compounds are Mono-Bhautic compounds,
 i. e. compounds of different substances
 which are isomeric modes of the same
 Bhūta.

(a) Mono-Bhautic compounds of the first
 order :—Under the impact or impulse
 (चमिषात or चीदन) of heat corpuscles, the
 substances in chemical contact (चारमक
 संयोग) break up into their atoms. These
 atoms are homogeneous, possessing only
 the original physical and chemical charac-
 ters of the Bhūta concerned. As the speci-

fic differences between isomeric substances arise from the arrangement or collocation of the atoms, the substances lose their distinctive marks on decomposition into the latter.

(न च परमाणुषु अपरजातिभेदो विद्यते न च
दृश्योऽस्माद्विबीजपरमाणूनां कश्चिद्विशेषः ।

Uddyotakara, Chap. III, A'hoika I,

Sūtra 4. न च सकृद्योचिदपरमाणूनां कश्चि-

विशेषः पार्थिवताविशेषात् । Śrīdhara, Nyāya-

Kandali, (इतिरिति वचनम्) । Under the

continued impact, (or, it may be,

impulse) of heat particles (विद्यता बहि-

द्व्येष कीदृशान् आदवातान् वा—Jayanta),

these atoms take on new charac-

ters. It is heat and heat alone that

can cause this transformation of the

colours, tastes, smells, etc., in these

original Bhūta-atoms. What parti-

cular colours, tastes, smells or physi-

cal characters will be produced in the

atoms depends (1) on the nature

of the constituent substances in con-

tact, (2) the intensity or degree of

the heat (छुर, सद् or सज्जम वाक्), and

(3) the species of Tejas-corpuscles

the impinge on the atoms, or the nature of the impact (विलस्यतेऽसंयोगः). (न दूरीऽपि संयोगात् एकस्मात् क्वादप्येति अपि तु पूर्वक्वादिविज्ञेयमित्यात् । यदद्रव्यं पश्यते अद्रिस्तंयोगेन तस्य हि पूर्वक्वादवस्थां यः सम्यगी विज्ञेयस्तद्विज्ञेयः अद्रिस्तंयोगः सत्त्वान् क्वादीन् विज्ञिष्टानास्महे । *Vide* also *Uddyo-
takara* III, 2, *Sūtra* 14. *Cf.* also *Vāchaspati*, I, 1, *Sūtra* 4. अणुकमश्चे
अपि क्वादानस्य विदरस्य बीजापरकालस्य च
अद्रिस्तंयोगस्य पूर्वक्वादिविज्ञेयानां कारणानां भेदात्
विज्ञिष्टातीया जायन्ते नन्वपरपक्षमा इति विज्ञातः ।)

Now when the atoms have all been determined in the same way, they begin to recombine again under the impact (or impulse) of the heat-particles in binary molecules, (or tertiary, etc.), and these in higher aggregates. It seems to be generally held that, at the final step one or more atoms of one constituent substance unite with one or more atoms of the other constituent substance or substances to form a molecule of the com-

pound; but the question is not of much significance for Mono-Bhautic compounds of the first order, as, in these cases, the atoms have before this all lost their distinctive characters and become homogeneously transformed. The compound so produced will possess the new characters of the transformed atoms, so far as taste, colour, smell, etc. are concerned, but as the molecular arrangement or structure (= त. वाक्कुलितम्) may vary, different compound substances may result from the same components.

- (b) Mono-Bhautic compounds of higher orders :—Again, Mono-Bhautic compounds of the first order may chemically combine to form higher compounds, and as the ultimate Bhūta substratum is the same, the process of decomposition and recombination will be essentially the same as before. The only doubtful point is whether in this case the component compound substances are broken up only into their constituent molecules, or into the original homogeneous Bhūta atoms. Some of the later Vaisesika Scho-

liasts hold that the latter happens in every case of chemical composition, however complex, but the earlier Vaiseshika conceived that in the case of compounds of compounds, the decomposition does not proceed so far as the original Bhúta atoms ; but that it is the specifically determined atoms constituting the molecules of the component compounds that are transformed under the impact of the heat-corpuscles ; and then one such transformed atom (one or more according to another version) from the molecule of one component unites with one similarly transformed atom (one or more according to the other version) from the molecule of the other component. Prasastapada, the great Vaiseshika Doctor, holds this view. When, for example, in the fertilised ovum, the germ and the sperm substances, which, in the Vaiseshika view, are both isomeric modes of Earth (with accompaniments of other Bhútas), unite, both are broken up into homogeneous Earth-atoms, and it is these that chemically combine under the animal heat (and bio motor

Energy, वायु) to form the germ-plasm (कलस्य). But, next, when the germ-plasm develops, deriving its nutrition from the chyle (blood) of the mother, the animal heat breaks up the molecules of the germ-plasm into its constituent atoms (कलस्यारम्भकपरमाणवः). i.e., into atoms specifically determined, which by their grouping formed the germ-plasm, and then these germ-plasm atoms as radicals chemically combine with the atoms of the food constituents, and thus produce cells and tissues. (समुत्पन्नप्राकृतैः कलस्यारम्भकपरमाणवैः)

अदृष्टवशात् उपजातक्रियैः
आहारपरमाणुभिः युक्तं सुक्ष्मं शरीरालसम्भवे
इत्येवा कलना । पितुः युक्तं मातुः शोचिर्तं तयोः
सतिपातानसर् कटरागलसम्भवात् एकद्वौचित्यारम्भेषु
परमाणुषु पर्येकपादिविनाशे सति समानगुणानुरोत्पत्तौ
वायुकादिप्रकृतेषु कलस्यशरीरोत्पत्तिः ।

...तव मातुराहाररसः मावशा संक्रामति अदृष्टवशात्
तव पुनर्मटरागलसम्भवात् कलस्यारम्भकपरमाणुषु
क्रियाविभागादिव्यापिन कलस्यशरीरे नष्टे समुत्पन्नप्राकृतैः
कलस्यारम्भकपरमाणुभिः अदृष्टवशात् उपजातक्रियैः

वाङ्मयपरमाकुम्भिः सङ्गं सम्भूय प्रतीरात्मरमादभ्यते
 इति वा। कल्याणः। Śīdhdhara, Kandali,
 बुद्धिबौद्धिकवक्त्रम् ।) In this hypothesis
 (कल्याणः), it is assumed that the
 atoms are similarly transformed, i.e.,
 become endowed with the colour,
 taste, smell, etc. of the product (the
 cell or tissue), the moment before
 the chemical combination takes place.
 Similarly, when milk is transformed
 into curd, one view is that the trans-
 formation takes place (under internal
 heat) in the constituent atoms of
 the milk molecules, atoms specifically
 determined as milk, and not in the
 original atoms of the Bhūta (or Bhūtas)
 entering into composition of milk.
 (Cf. एवं सदादुग्धपरमाकुम्भिः परमाकुम्भिरेव दध्ना-
 रभ्यते । एकमद्विखेयं दध्नापरमाकुम्भिरेव पर-
 माकुम्भिर्नैवदीक्षारम्भाः इति दिक् । Nyāya-
 bodhinī, on Annan; Bhatta's Tarka-
 saṅgraha.) Cf. Dīnakarī, on the other
 hand—राजकुलस्यपदुग्धस्य'दध्ना'रभ्यते' इति तस्य (दध्नाः) ।
 In these cases, the atomic contact
 is called constituent contact

(चारण्यकसंयोग), and all the atoms are equally regarded as material causes (उपादानकारण or समवधिकारण) of the compound.

- B. Hetero-Bhautic 'quasi-compounds'.—The Nyāya-Vaiśeṣika maintains that in the case of bi-Bhautic (or poly-Bhautic) compounds, which are only quasi-compounds, there is another kind of contact between the heterogeneous atoms of the different Bhūtas, which may be called dynamic contact and is distinguished in its operations as Upashtambha, Vishtambha or Avashṭambha (उपसृष्टम्भ, विसृष्टम्भ or अवसृष्टम्भ). In some cases, it so happens that the atoms of different isomeric modes of the same Bhūta do not chemically combine under the mere application of heat ;—they require to be surrounded (and 'excited', 'energised') by atoms of different Bhūtas. For example, in the case of the oils and fats as well as of plant saps and fruit juices the Earth-atoms must be dissolved in water (Ap), and it is only when the water atoms (Ap-atoms) congregate round the former that dynamic intra-atomic

forces are set up, and the Earth-atoms (with the water atoms in dynamic contact) now take on peculiar infra-sensible characters (colours, tastes, smells) under the impact of the heat corpuscles, and then, under further impact, fall into groupings or collocations (of a very peculiar nature, to be presently explained) which determine the nature of the composite substance thus produced. Here it is the water-atoms that are dynamic (उपपद्यक), and excite the Earth-atoms, and these substances, oils and fats (तेजवर्ग and वृत्तवर्ग), as well as acids (चमकवर्ग) are, because of the Earth radicles regarded as Earth-compounds (or Earth-substances). (पाकज-तथाविधमन्त्ररसकपादिसहिः परमाणुभिर्द्रव्यकादिकमेव वृत्तादिद्रव्यमारभ्यते । तत्र च उपपद्यकतया निमित्ततामापन्नः पानीयावयवाः । तेषां द्रव्यकसमवायेन वृद्धसमीपकभ्यते । तेजचौरादिव पार्थिवत्वसिद्धिः । तेजस्य भौमान्तेत्यन्तत्वाद् वृत्तवत् । Udayana). In the above instances, Ap (water) acts as dynamic (Upash-tambhaka, (उपपद्यक), but Tejas

and Vāyu can also act in the same way on Earth-particles. Conversely, Earth-particles may act dynamically on the atoms of the other Bhūtas. For example, in the case of mercury and the metals which are conceived in the Nyāya-Vaiśeṣika to be igneous bodies (in fact they are supposed to be formed under the subterranean heat चाकरज), the Tejas corpuscles are believed to form the radicles, and the Earth-particles are dynamic (उपचक्षक). (सुवर्णादि निरन्तरं भावमानस्यैव पृथ्वीकस्य लक्षणात् । तस्मैव द्रव्यान्तरैश्च प्रतिबद्धत्वात् उपचक्षकवीर्यं पार्थिव-भागः सहस्ररूपं एवानुवर्तते. यत्तु पुटपाकादिना रक्तसारता दृश्यते तन्निर्वीभूताभिभावकतया द्रव्योप-गमात् । एतैश्च पारदादि व्याख्यातम् । Udayana, Kiranārvali, तैजानिकपञ्चम् । Cf. also वीर्यं तेजसनिष्पत्तिं सुवर्णे तेजासाश्च पार्थिवी भाग उपचक्षक एवम् ।)

It may be here noted that Gaṅgeśa, the author of the Tattvachintāmaṇi, conjectures that even gold can be evaporated or made to disappear by the application of intense heat ;

अथ द्रुतद्रुततरादेः कर्मणः प्रतीतिः इत्यलङ्कार-
संवीचीनं सुवर्णनाम्नां तद्वद्वत् नञ्छति । But
Mathurānātha notes here—मथुराकाली-
च्छेदसमी । (सन्निकर्षवादरुद्धम्).

But while every Bhūta can act dyna-
mically as उपद्रवक 'energiser',
'exciter', it is the Earth-Bhūta alone
which is capable of exercising the
power of arrest or inhibition of
molecular motion or the motion of
particles due to gravity as in fluids
(Vishtambha, *fatwa*), or the power
of counteracting the tendency in a
given set of atoms to fall into a pe-
culiar order or group (व्यूहविरोधित्वम्),
(न च पार्थिववत् अथो द्रव्यान्तरं यच्छेदितव्यमिति
पूर्वेव्यूहं वा विरुद्धम् । Udayana, Kira-
nāvalī, इष्टिवीतिरुपपन्नम् । विदग्धकलं स्वाभा-
विकगुणत्वाच्चद्रव्यान्तरगतिरतिव्यवकलम् । व्यूहविरोधित्वं
च स्वाभाविकगुणवत्पुनरातिव्यवकलम् । Vardha-
māna, Kīranāvalīprakāśa, *ibid.*)

Oils, fats, milks—Bi-bhautic quasi-compounds,
with Ap as energiser :—Oleaginous substances

(आम्लतेजोदहः स्त्रीषः) are divided by Udayana into (1) oils, derived from vegetables, (2) butters derived from milk, and (3) fats derived from animals. The medical schools, as we have seen, recognise animal oils as distinguished from vegetable oils. Vegetable fats (e.g. तिलतैल) are also mentioned. Vāchaspati in the Tātparyyatīkā contends that mustard oil has not the flavour and smell characteristic of the true oils (sesamum, linseed etc.), and is classed with the latter by convention. Judged by the flavour test. A'miksha (the casein substance formed by mixing milk-curd with hot boiled milk) is to be classed with milk substances. So also Takra, whey,—but Vājina, the thin fluid that is left after the Am'iksha (casein substance) is separated, cannot be classed as milk.—It may be added that the milks and curds as well as oils and fats derived from different species of vegetables or animals are supposed to differ in their ultimate structural arrangement and therefore in kind; but Vallabha thinks that the ghees (clarified butters) prepared from different kinds of milk are of the same kind, in other words, the milks and curds are 'polymeric', the ghees (clarified butters), 'isomeric', using these terms, as before, in a loose general sense..... तैलद्रव्यसामानां भोज्यसौ-
म्यंयोनित्वात् । अतएव तानि केचन सौम्यापि तैलम् रसादि-

सःक्यादपि तु एतच्चपदेनच । Udayana, Kiranāvali, पूर्ववतीनिरूपणम् । Vallabha notes that ghees do not differ in kind, as milks (and curds) do :—
 अतो साक्षिणगव्यादिदुग्धेषु दधत्ववत् एतादिषु जातिभिद-
 एवास्मानिति चेत् ।—Vallabha, Līlāvati. Compare Vāchaspatī, II, 2, 65 :—वाच्यतैसादीनां जातिषु गर्भेन वा रसेन वा व्यज्यते । अतएव न सार्वपादीनां तैलत्वमस्ति । तदासकयो-
 रैवैवसयोरभावात् । भाक्तषु तैलस्यद्वयः । चौरजातिरपि रसव्यङ्गेव ।
 अतएवाभिधावाः चौरत्वम् । न तु राजिनस्य तदव्यञ्जकस्य रसभेदस्य
 राजिने अभावात् आभिधावां न भावात् ।

III. Mixtures like soups, solutions etc :—A soup is a physical mixture of a peculiar kind, from which evaporation ordinarily sets the water free (cf. Udayana's चनवीतमुक्त infra). When meat is boiled in water, there is the application of heat, with chemical changes in the meat, but the combination of meat-particles and water-particles in the soup is only physical combination, and not a chemical one. It is of course not a true compound, neither is it a quasi-compound, like milk (in which the water-particles are 'energisers' of the Earth-particles). Milk, for example, retains its milky substance, when it coagulates or becomes solid, (this of course is also the case with mono-Bhautic substances whether elementary or compound, e. g. water, which becomes ice,) but the substance we call a soup or solution ceases to be a soup

or solution, the moment it solidifies. Uddyotakara notices gruel, baths, and lyes (alkaline solutions) as mixtures of this class (एतेन पाक्काशिकविशेषावधारणः प्रसूताः । Vārttika, Chap. I, A'hnikā 1, Sūtra 14).
 यद्ये हि नात्र उत्पन्नपाकज्ञानं द्रव्याणां कालविशेषानुवर्तते इति
 द्रव्यान्तरसंयुक्तानां पाकजीवन्तो यः संयोगः स दूष इति । एतेन
 पाक्काशिकविशेषावधारणः प्रसूताः । Uddyotakara, Vārttika,
 Chap. I. A'hnikā 1, Sūtra 14. Vide also Vāchas-
 pati's comment : उत्पन्नपाकज्ञानं नैवेत्यर्थः यः विघ्नसि-
 विद्यावशनां द्रव्यान्तरिणं तीक्ष्णं संयुक्तानां पाकजीवन्तौ सन्तौ न
 चासौ सङ्घातः प्रसूतं कालविशेषानुवर्तते सतीति । स च संयोगमेव
 एव तीक्ष्णसंयोगेनैव सङ्घातो निकासीयवीरकारणकत्वात् । नापि दूषणातीत्यं
 तीक्ष्णयोगिनि द्रव्यं औरजातीयमिवेति युक्तम् । तीक्ष्णवर्तते काठिन्येऽपि
 औरतुल्यव्यपदेश्योक्तदृष्ट्यात् । इह तु काठिन्ये न दूषवृत्तिव्यपदेश्यो
 इति सन्त्यमेव एव तीक्ष्णसंयोगेऽपि इति व्याजम् । स च सत्प्रभवसिद्धः
 संयोगित्वतिरिक्तः । Vāchaspati, Tātparyyatika, *ibid.* For
 salt and alkaline solutions, *vide* Kiranāvalī—यत्
 पुनरन्युपि सिद्धिर्भवेत्तु चारादिरपि रसः पाकस्यैव सत्प्रभवस्यैव स
 दम्यमूलकवायस्यैव पारिषद्द्रव्योपाधिकः । सप्तमस्यैव तस्यैव सप्तमोऽनुक्तस्य
 रसो गन्ध एव । Udayana, Kiranāvalī, अल्लसिद्धयम् ।

Chemical action and Heat:—The operation of heat is of course universally implied in chemical

combinations. Where the application of external heat is wanting, Vātsyāyana, the great Doctor of the Nyāya, points to the operation of internal heat. (e.g. पृथिवीधातुः अन्धातुना संयुज्जीतः आन्तरिक तेजसा पचमान, रसद्वयं निर्वर्तयति।—Vātsyāyana-Bhāṣhya, Chap. IV, A'hnika 1, Sūtra 47). In the case of combustion, we have seen Vijñāna-bhikṣhu explain the heat as latent in the Earth-substance, the fuel, from which it breaks forth. Udayana points out that the solar heat is the source of all the stores of heat required for chemical change in the world. The change of colours in grasses, for example, is due to Tejas, in the form of latent (invisible) heat, not in the form of Agni; and the cold in winter cannot take away this store derived from the Sun. (हृद्यादिविकारी हि यदि हृद्यादिवराहनि-
मावहेतुः स जूनमीश्यापेक्षेण तेजसा कर्तव्यः। तादृशे च पाके
अग्निमिते हिममिति। न किञ्चिद्विहृतमापद्यते। न हि सौरस्य
तेजसः प्रेक्षीयपाकहेतोर्हिमादपगतः समती। अथ विकारी भस्मादिकपी
निर्वाच्यः सोऽस्मिन् एव हिमद्वयेषु हृद्यादिषु क विरीधी बाधी वा।
अथ हृद्यादिवराहनिमादेकैव अग्निः साध्यते तदवयवम्। तस्य
दर्शनसमर्थनयाहस्य सोम्यानुपलब्धवाधितत्वात् अतादृशस्य तेजीभावस्य
निर्गमरसकत्वात् अनिहत्वात् च। Udayana, Kiranāvālī
सहितसंहारविधिविदपचम्।) Similarly, it is under this
solar heat that the unripe mango ripens, i.e. changes

colour, taste, smell etc., showing that there is chemical transformation or subtle decomposition and recombination going on; and this is also the case with the rusting of the metals, which is a combustion due to the solar heat (सूर्यपाक) even as the conversion of food into chyle and of chyle into blood are instances of chemical action due to the internal animal heat (जठराग्नि or सौद्वी भस्म). But the kind of contact with heat-corpuscles, in other words, the kind of chemical action (पाक) which transforms colours is supposed to differ from that which transforms flavour (विस्फुल्लितः संयोग) and पाक) and this last from that which produces a change of smell, or tactile quality, (पाको नाम विज्ञातीयतेन; संयोगः । स च नानाज्ञातीयः । कपञ्जकी विज्ञातीयतेन; संयोगरूपवत्तया रसजनकी विज्ञातीयः । एवं स्वादी अपि तथा । एवमकारेण विस्फुल्लितज्ञातीयः पाकाः कार्यैर्विज्ञातयेन कल्पनीयाः । तथाहि तत्त्वबुद्धिनिविज्ञायाऽदौ तत्त्ववत्त्वविज्ञातीयतेन; संयोगान् पूर्व-हरितकपनाश्चकानरश्च पीतादिवत्पतिः पूर्वैरसस्य चक्षुष्येवानुभवान् । कश्चिन् पूर्वहरितकपसत्त्वेऽपि रसपरवर्तितवृत्त्यते विज्ञातीयतेन; संयोग-रूपवाक्यवशात् पूर्वतनः स्वरसनामि मधुररसज्ञानुभवान् । तस्माद्पु-लकनापेक्षया रसजनकी विस्फुल्ल एव संज्ञजनकी विस्फुल्ल एवाङ्गीकार्यः कपरसयोरपराहतौ अपि पूर्ववत्त्वनामि विज्ञातीयपाक-मज्ञान् स्वरभिन्नस्वीयवर्त्यः । एवं स्वाभजनकीऽपि पाकवशात् कटिन्-

अर्थनामि बहुलार्थादुभयात् । अतएव पार्थिवपरमाणुनामिकजातीयत्वेऽपि
 वाक्यमहिम्ना विजातीयद्रव्यान्तरानुभवः । यथा सौम्यतृष्णादीनां आपर-
 माणुत्वं ज्ञेयं अथारम्भकपरमाणुषु विजातीयवैजःसंयोगवशात् पुन-
 र्कषादिषुत्पद्यमाने तदनन्तरं दुग्धे मादधं कषादिकं वर्धते
 तादृशकपरमसम्पत्तौजनकाशेकःसंयोगा जायते । तदुत्तरं तादृशकपादय
 त्वमवयवी । तादृशकषादिविशिष्टपरमाणुभिर्द्रव्यवायुकमारभ्यते । अतः
 नायकादिकमेव सहायुन्धारम् भवति : Nyāyabodhini (on
 Annam Bhaṭṭa's Tarkasamgraha), Heat and light
 rays are supposed to consist of indefinitely small
 particles which dart forth or radiate in all directions
 rectilineally with a sort of conical dispersion and
 with inconceivable velocity. They may either (1)
 penetrate through inter-atomic (or inter-molecular)
 spaces as in cases of conduction of heat which when
 applied under the pot boils the water, or fries the
 paddy where there is no chemical action in the pot,
 no decomposition and recombination of its atoms, no
 change in the molecular collocation ; or, as with light
 rays in cases "of translucency or transparency
 (सञ्चलन) penetrate through the inter-atomic spaces
 with Parispanda of the nature of deflection or
 refraction (तिर्यग्गमन, Udyotakara), in the same
 way as when fluids penetrate through porous bodies
 (तप्त परिष्कन्तः तिर्यग्गमनं परिस्तरः पात इति—Udyo-

takara, commenting on Vātsyāyana's परिचय-
परिचयौ, Sūtra 47, A'hnika 1, Chap. III.) or (2)
impinge on the atoms, and rebound back—which
explains reflection (सूक्ष्म, विरचयित—Varāhami-
hira, रश्मिःपारर्चन—Vātsyāyana) or otherwise be
obstructed by the atoms in their path, which would
explain degrees of opacity, the casting of sha-
dows, etc., all these operations being also physical,
and unattended with decomposition and recom-
position or alteration of molecular grouping, or
(3) lastly, strike the atoms in a peculiar way,
so as to break up their grouping, transform the
physico-chemical characters of the atoms, and again
recombine them, all by means of continual impact
with inconceivable velocity, an operation which
explains all cases of chemical combination.
(चिन्तयति हि तेजसो जायमानस्यैव वेगानिमग्नः सत् प्राचीना
चलच्चक्रावस्थिति एव भगवति मयूखमाश्रित्य मयूखोदरेषु प्राचीन-
द्व्यभिमानो लौकिकानाम् । (Udyana, Kīrānāvalī, तेजोनिष्कपम्
—taken from Vāchaapati, Tātparyyatfā. द्रव्य-
संघटनम् ।) Cf. also (वाचस्पति तेजः वेगवता साधितेन
तेजसा न प्रतिघ्नन्ते । Vāchaspati—वर्तिदेशे पिच्छितमपि तेजः
प्रक्षर्यन् प्रासादोदरं व्याप्नोति । तत् कस्य देशीः दृश्यमानम् ।
समागतः प्रसरदपि न क्षपयिमाणातुविधादिनं प्रक्षयमाधत्ते किं
तु विषयमेदातुविधादिनम् । *ibid.* Cf. कटिकायनरिषोपसंख्यारवि

प्रसादस्य भावस्य। स्फटिकादीनां तैलोजनेरप तिस्रश्चकतवः प्रदीपमभा-
देनोपपद्यते। Udayana, तैत्तिरीयिकवचम्, in reply to the
objection—अदि हि द्वाव्यं यद्वीर्यात् प्रतिघातिना स्फटिकद्वयेषु
विद्यमानादभावं प्रसवेणैवादिकं वाददीत तस्मादमाच्छकारि ततो न
तैलसम्। (Udayana, *ibid.*) Definition of स्रक्ता—
द्रव्यान्तराभ्युत्पद्यमानस्यः स्रक्ता। दृष्ट्याप्रतिघातः स्रक्ताभ्य-
पटलस्फटिकाकारितीत्यर्थः। स्रक्तादिषु च वाचकस्य
तैलस्योपतिघातात्। Uddyotakara, Chap. III, A'huka
1, Sūtra 38. आदित्यरश्मिः स्फटिकान्तरितोऽपि दृष्टोऽभि-
घातात्। Sūtra 47, where Uddyotakara notes—कोऽप-
मभिघातः—इत्यं द्रव्यस्यावयवा न व्युत्पन्ते तस्य चतुर्भावयैः
अव्युत्पन्नानस्य सोऽभिमित्यस्यः सोऽभिघात इति। Vāchaspati
explains यस्य द्रव्यस्य भर्जनकपालादीः अवयवा न व्युत्पन्ते
पूर्वोत्पन्नद्रव्यान्त्यकसंयोगनाशेन द्रव्यान्तरजनकसंयोगोत्पादनं व्युत्प-
न्नस्य कियन्ते तस्य द्रव्यस्य भर्जनकपालादीव्युत्पन्नानस्य
अन्तरावयवैर्दोऽभिमित्यस्यो वहुः सोऽपतिघातः। Cf. Vātsyā-
yana on Sūtra 47, A'huka 1, Chap. III. On the
other hand in chemical combination, अन्तःप्रवेशः
कृशानोरनुगोचरे। तैल विगमता अद्रिद्रव्येण मोदनात् अभि-
घातात् वा अत्र यदेव कियते, कियतीति विभावः, विभागात्
आरभ्यकसंयोगविभावः *etc.*—Jayanta, Mañjarī, भूतचैतन्य-
पूर्वोपपत्तिः। For opacity, shadows, *etc.*, *ibid.* क्वाया तु
तैलः परमाधीरावरणात् कुर्यात्तमता परमाधुना तैलः परमाधु-
रातिवर्ते। यत्र च अस्मिन् आवरणे तत्र च्छादयेति। विरल-
तैलः स्रक्तादीनि द्रव्यवृत्तकस्यापि च्छाया द्रव्यमिधीयते। सर्वस्यो

कादृशमेतःप्रकाशोऽपि न जाति रतःसंज्ञकानि । Uddyotakara, Chap. IV, A'hnika 2, Sūtra 25. For reflection, and its laws, I quote passages in my paper on Hindu Physics and Mechanics, to which the student of the history of Optics is referred.

Arrangement of atoms in Space:—The Nyāya conceives atomic magnitudes as *Pārimāṇḍalya*, a term which indicates a spherical shape. (निम्न परिमण्डलम्—परिमण्डलमेव पारिमण्डलम्—*Saṅkaramitra*). To conceive position in space, *Vāchaspati* takes three axes, one proceeding from the point of sunrise in the horizon to that of sunset on any particular day; (roughly speaking, from the East to the West) ;—a second bisecting this line at right angles on the horizontal plane, (roughly speaking, from the North to the South), and the third proceeding from the point of their section up to the meridian position of the sun on that day, (roughly speaking, up and down). The position of any point in Space, relatively to another point, may now be given by measuring distances along these three directions, i.e. by arranging in a numerical series the intervening points of contact, the less magnitude or distance being that which comes earlier in this series, and the greater that which comes later. The position of any single atom in Space with reference to another may be indicated in this

way with reference to the three axes. But this gives only a geometrical analysis of the conception of three-dimensioned Space, though it must be admitted in all fairness that by dint of clear thinking it anticipates in a rudimentary manner not only the foundations of solid (co-ordinate) geometry, but also of the geometry of position, and especially the conception of Space as a Manifold, which alone can serve as the basis of a generalisation comprehending all different possible kinds of geometry, Euclidean and non-Euclidean.

(एकलेष्टिं दिशः आदित्योदयदेशस्यादशदेशरजुको यः स इतरकाद्विषमदशदेशसंयोगात् परमाणोः पूर्णः एवमादि-
त्याकस्यदेशस्यासदशसंयुक्तौ यः स इतरकाद्विषमदश-
संयोगात् परमाणोः द्वायनः तौ च पूर्णवद्विभौ परमाणु-
चपेक्ष्य तः सूर्योदयाकस्यदेशविषमदशसंयोगः स सप्त-
वर्णः। एवमितथोर्वी त्रिर्यग्देशसन्वितौ सप्तस्य आर्जवेन
न्यवस्थितौ सार्धवर्तिनौ तौ द्वाविंशतेरौ परमाणू। एवं
सप्तान्द्विर्वाहसूर्यसंज्ञिकार्धविप्रकर्षौ चपेक्ष्य सप्तसंयोगावो
दृश्यः। संयुक्तसंयोगाव्यवसूयत्वे च सन्निकर्षविप्रकर्षौ पूर्ण-
संज्ञावन्ति जलं च अत्यन्तं परसंज्ञावन्ति जलं च सूक्ष्मम्।
Vāchaspatī, Tātparyyatīkā, Chap. IV. Āhnika 2,
Śūtra 25.

The original physical arrangement of atoms is also given. Each atom is in contact with six other atoms, which gives a cubical arrangement. एवं

दिशीऽपि एकस्या जपि संयोगा एव भागाः कीदृशं परमाणुः
 षट्केन युगपदयोगी मूर्तत्वमावयुक्तः न सावयवत्वमयुक्तः । *Ibid.*
 Cf. also the objection in the Buddhist *Kārikā*.
 षट्केन युगपदयोगी परमाणुः षट्केता । यथा समानदीप्तत्वे
 पिण्डः स्वादृक्प्रकाशकः ॥ This is the typical primordial
 arrangement, and variations in the collocation
 of atoms and molecules (जुह, सनयनसन्निवेश), as
 we have seen, were conceived to account for
 the variety of isomeric modes of the same Bhūta,
 as well as of mono-Bhautic and poly-Bhautic
 compounds.

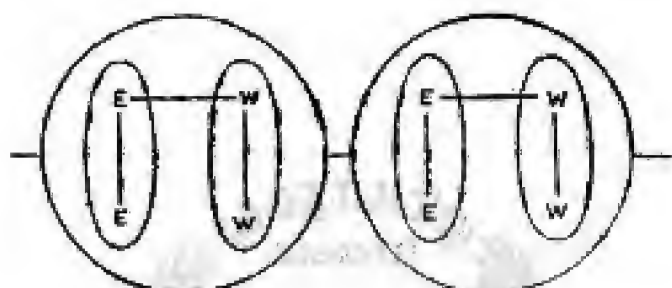
The molecular arrangement in the case of
 bi-Bhautic compounds is very peculiar. Two sub-
 stances, say Earth and Ap. (water), form a quasi-
 compound, first, and each substance breaks up
 into atoms, one atom of Earth comes into contact
 with one of Ap. But the two do not form a binary
 molecule. Instead, this contact of heterogeneous
 atoms leads to a curious result. The atom of Earth
 combines with a neighbouring atom of its own class,
 and forms a binary molecule. Simultaneously
 the atom of Ap combines with another Ap-atom,
 and forms a binary molecule. Now the first binary
 molecule links on to the atom of Ap, and
 similarly the second binary molecule links
 on to the atom of Earth. The moment after,
 the two binary molecules take on the physico-

chemical characters of Earth and Ap respectively, and simultaneously with the assumption of these physico-chemical characters, the binary molecules enter into complex contact (संयोगश्च संयोगः). In all this process, work is done only in the first instant, in the contact of an atom of Earth with one of Ap—the resulting contacts, of atom with binary molecule and of the binary molecules with each other, involve no further expenditure of Energy. Thus we get a particle holding two binary molecules (of Earth and Ap respectively) in complex contact, and such particles continue to be formed. In this way the particles of the two substances arrange themselves, and the peculiarity of this molecular arrangement explains the resulting mixed or compound qualities of this class of quasi-compounds. (संयोगश्च संयोगः) उत्पन्नमादस्य

विद्यमानस्य वा निष्क्रियस्य कारणसंयोगिकारणः कारण-
कारणसंयोगपूर्वकः कार्यकार्यगतः संयोगः ।..... एक-
काय इवोत्पत्तिः कथम् । यदा पार्थिववायवीरस्त्रीः संयोगी
सति चन्द्रेण पार्थिवेन पार्थिवस्य चन्द्रेण चान्येन च
आप्यस्य पुनरप्यसंयोगो भवतश्चदा ताभ्यां संयोगाभ्यां पार्थि-
वाद्ये हायुके पुनरप्यसंयोगे । ततो यस्मिन् काले हायुकयोः
कारणगुणपूर्वकमिव हवाद्युत्पत्तिः तस्मिन्नेव काले इतरैर-
कारणकारणगताम् संयोगान् इतरैरकारणकार्यगतौ संयोगौ पुनरप-
त्ययेते । किं कारणम् । कारणसंयोगिता हि चकारेण कार्ये
भवत्येवं संयुज्यते इति ज्ञायः । अतः पार्थिवे हायुकं कारणसंयोगिता

आद्येन अमुना सम्यक्ते । आद्यमपि द्वातुलं कारकसंकीर्णम् । पार्थिवैवेति
(Prastapāda-Bhāṣya, गुह्यसूत्रे संकीर्णनिवृत्तम् ।)

The whole process may be graphically represented as follows :—



E = an atom of Earth.

W = an atom of water (Ap).

E
|
E = a binary molecule
of Earth.

W
|
W = a binary molecule
of water (Ap).

Molecules of a bi-
Bhautic quasi-com-
pound;—graphic for-
mula of complex
contact.

I will conclude this account of ancient (and
medieval) Hindu chemistry with a note on the
conception of molecular (atomic) motion, Paris-
panda, and the different varieties of such motion
which were conceived to account for the physical
phenomena of sound, light and heat. Any attempt
to differentiate rigidly between Mechanics and

Physics on the one hand and Chemistry on the other at this primitive stage would be an idle affectation. My paper on Hindu Mechanics and Physics will give a detailed exposition in a separate treatise.

Parispanda :—Resolution of all physical action into motion :—

Parispanda sometimes stands for motion molar as well as molecular, but more often for the subtle motion of atoms or molecules. The radical meaning of the term is whirling or rotary motion, a circling motion, but it may also include simple harmonic motion (e. g. vibration). All action, operation, work (कृत कार्य) is ultimately traced to this form of subtle motion lodged in the atoms or in the matter-stuff. The Vedānta, for example, speaks of a cosmic vibratory motion (सर्वलोकपरिवन्दन—Sāṅkara).—Ākāśa, in the Vedānta, as we have seen, is the first stadium in the evolution of Matter, which gives off Vāyu, which gives off Tejas, and so on; but Ākāśa (Ether) itself passes through two stages before the emanation of the Sūkshmaabhūta Vāyu :—(1) the motionless ubiquitous primordial matter-stuff (answering to the Sāṅkhyā Bhūtādi) called Purāṇam kham (प्राणम्) and (2) a subtle integration, the pure unquintuplicated Sūkshmaabhūta called Vāyuram Kham

(सत्पुंल्ल) (answering to the Sāṅkhya Tanmātra stage). It is this subtle Aṅkāśa, in its Tanmātric integration, i. e. in the derivative form, which is subject to an incessant Parispanda. The gaseous stage of matter (the Vedāntic Vāyu) is indeed matter in a state of Parispandic motion (वायुः परिस्रव्याकलनात्—Sankara). So also the bio-motor and sensori-motor principles apart from the directive Intelligence of the Self (नाभश्च परिस्रव्याकलनादेव—वदन्तेनम् सूक्ष्मं सूक्ष्मं तत्त्वतो मनःसन्निवन्नायम्—Sankara). The Sāṅkhya also conceives this Parispanda to characterise every process and phenomenon of cosmic evolution (सर्वं स्रजिर् परिस्रव्यात्—Vāchaspati, Kaumudī). Bhūtas, organisms, mental organs, as modes of Prakṛiti (considered apart from the Intelligence of Puruṣa) are all subject to this Parispanda बुद्ध्यादयो ईदृश स्रजिर् देहाकारं उपाददन्ते इति तेषां परिस्रवः। इरीरपञ्चकादीनां च परिस्रवः प्रसङ्ग एव।—Vāchaspati on Kārikā 10). On the other hand, Prakṛiti as the Avyakta, the a-cosmic, the un-manifest ground, with resolution only of like to like (सदृशपरिणाम), is devoid of all Parispandic motion (उदादि अव्यक्तास्तापि परिस्रावस्तथा क्रिया, तथापि परिस्पन्दो नास्ति। *ibid.* on Kārikā 10). The Nyāya-Vaiśeṣika finds Parispanda in all

forms of matter, except A'kāśa which, in that system, is non-atomic and incapable of any change or activity (चक्रिणः). But all atoms from those of Vāyu downwards, are in incessant motion. The world at bottom is an infinitude of continually whirling (or vibratory) particles (अनवरतपरिचक्षु-मात्रापरिमितपञ्चमादिपरमाणवः—Rāghanaṭha :—compare also Udayana-Kuṣumāñjali, Stavaka V.—परमाणवः हि गतिर्बौलत्वात् परमव्यपदेशः परतीति ।), All physical action consists in motion. The Nyāya-Vaiśeṣika rejects force, power, operation (शक्ति) except as modes of motion. Jayanta indeed states : we do not acknowledge any mysterious power or operation, which the senses do not and cannot report to us. But this denial of Force (शक्ति) and of unperceived and unperceivable operation (अलोद्दिश्यकार) is put forward as a philosophical (epistemological and metaphysical) proposition to justify the Nyāya analysis of the causal nexus into mere invariable and unconditional antecedence among phenomena without productive power or efficiency अकारिनिश्चयस्य निवृत्त्यर्थम्—Bhāṣa-Paricchhedha). It is not of course intended to question the existence of Parispanda, which is of the nature of motion, and which, though subtle and therefore infra-sensible (सूक्ष्म and अनुभूतव्य, not अलोद्दिश्य), is the ultimate form of all physical

activity. (परिणाम एव भौतिकी व्यापारः करोत्यर्थः । अतो-
न्द्रियस्य व्यापारः नास्तीति ब्रूयते ।.....तस्मात् कारक-
बलैश्च चलता जगति फलम् । न पुनश्चलनादयो व्यापार-
उपपन्नम् । Jayanta, Nyāya-Mañjarī, Ahnika I).
The effect (no less than the action) is, in all cases of
material causation, the resultant of the combined
motions of the various (material and efficient)
causes involved (e. g. in the case of पाक-समुद्दि-
ह्येन्द्र्यादिसकलकारकनिकरपरिणाम एव विशिष्टफलावस्थितः पाक
उत्पद्यते । ... अथ व्यापार एवेव सत्यः संभूय साध्यते ।
किं फलेनापराधं न तदि संभूय साध्यवान् ।—Jayanta, Nyāya-
mañjarī, Ahnika I).

But, in the Nyāya-Vaiśeṣika, though all action
of matter on matter is thus resolved into motion,
conscious activity is sharply distinguished from all
forms of motion, as against the Sāṃkhya-Vedānta,
which, as we have seen, considered every thing
other than Intelligence, the Puruṣa or the trans-
cendental Self, to arise in the course of cosmic
Evolution, and therefore to be subject to Pariphan-
dic motion. (क्रियाविहीन एवायं व्यापारी ज्ञानुराकारः ।
अन्त्यात्मकवर्द्धिर्भूतक्रियासत्त्वविविधतः ।—Quoted in Jayanta's
Nyāya-mañjarī, Ahnika IV).

Santāna, i. e. Gati-santāna (including wave
motion and current motion or convection) : Kampa
santāna, Spandana, (vibration) :—Charaka notes

three kinds of *santānas*, serial motions, viz., those of water, sound and light (जलसन्तान, शब्दसन्तान and चक्षुःसन्तान). Chakrapāni points out that a wave of sound travels more rapidly than a wave of water, and much less rapidly than a ray of light. In Hindu Mechanics, a current of water (downward flow, सञ्चल) is conceived to consist of particles moving in an uninterrupted series under the action of gravity and fluidity (द्रव्य and द्रव्य). A ray of light implies the rectilinear propagation of indefinitely minute corpuscles, in all directions, with inconceivable velocity, and a sort of conical dispersion (चक्षुःसन्ताने हि वेगानिग्रहः तेजःसर्वत्र काशीति प्रत्यक्षत्वात् Uddyotakara—Vāchaspati). A wave of water (वीरि-तञ्ज) implies the transmission of vibratory motion in the water particles. (Cf. Jayanta—पञ्चदशतन्त्रोक्ति-संग्रहस्य अष्टमोऽध्यायः, A'hika II). A wave of sound is conceived by some on the analogy of a wave of water (वीरितञ्जान्ता), only the air-waves (cf. the Mīmāṃsā) or the sound-waves in and through the vehicle of air waves (cf. the Nyāya-Vaiśeṣika) travel by concentric circles not in one but in all planes. (N. B. this assumes transverse waves). Others hold that the air waves (cf. the Yākya-pādiya) or the sound and air waves (cf. Uddyo- takara) are propagated by the transmission of the vibration in all directions, leading to conjunction and disjunction of air-particles, so that the wave may be said to expand by alternate concentric

spherical layers of rarefaction and condensation (प्रचय) (N. B. this assumes longitudinal waves),— (कदम्बगीलकन्दाय—cf. संशोधनविभाग नैसर्गिक विज्ञानाः ग्रन्थमन्त्रालयी नादग्रन्थाद्याः (Savara-Bhāṣya 1—1—17) चमिवातिन हि मे जा वायवः क्षितिगतान् वायुमण्डलि प्रति धारयन्ताः स्रष्ट्वीदृशान् संशोधनविभागान् उत्पन्नदधन्ति ।—*ibid.* 1—1—18). The Vākya-pāṭya describes articulate sounds (Varṇas) and indeed all sounds (śabdas) as only forms of air set in motion, with rarefaction and condensation (प्रचय), and capable of variations of velocity and configuration (स्थानिचमिदन्ती वायुः ग्रन्थं प्रतिपद्यते । तस्य आरम्भकामर्शान् विनम्रचयचक्षिणः । सन्निपातान् विभज्यते । आरम्भजीदपि मूर्धनः—Vākya-pāṭya, Kānda I. Sloka 109) (*vide* my paper on Hindu Mechanics and Physics). (For the Hindu doctrine of scientific Method, *vide* Appendix; for certain interesting recipes of chemical technology, *vide* Addenda).

I had intended to conclude this survey of Hindu Physico-chemical sciences with a comparative estimate of the evolution of scientific ideas in the culture-history (kultur-geschichte) of the Chinese, the Greeks and the Arabs, as an Essay in the historico-comparative method of investigation (vide the Introduction to my Comparative studies in Vaishnavism and Christianity for a correction of this method), but space forbids, and the reader too, I fancy.

The Date of Rasaratnasamuchchaya.

While the present volume was about to issue from the press, Mr. T. G. Kāla, Editor of the Marhattā Journal "Samālekhaka", sent us a critical notice of R. R. S. As there are some important historical facts brought to light and as the date of this work arrived at from quite independent sources tallies with that assigned by us (Vol. 1. Intro. LXXXIX), we make no apology for reproducing its substance in a condensed form.

Charpati or Charpatinātha of the Nātha school is mentioned in the R. R. S., (see VI, 58, Poona edition), as also king Singhana.

The Navanātha Śaktisāra, a Marhattā work by Narahari Māla, gives some legendary information about this Charpatinātha and speaks of him as a contemporary of Matsyendranātha. On the left has

मत्स्येन्द्रनाथ

गोरक्षनाथ

मेलीनाथ

निहाचिनाथ

शानदेव

} been given the genealogy of the pupils of मत्स्येन्द्रनाथ. The last, शानदेव or शानेश्वर, was the celebrated Marhattā Saint and author of a commentary on the भगवद्गीता called शानेश्वरी.* It was written in Saka 1212,

i.e., A. D. 1290. So मत्स्येन्द्र and Charpatinātha must have lived at the *beginning of the thirteenth century A. D.*

*See the concluding portion of शानेश्वरी, a Marhattā work.

The R. R. S. which mentions the Siddha Char-pati must be therefore later than the first half of the thirteenth century A. D.

सिद्धचर I (A.D. 1069)

सिद्धचर I

सिद्धचर I

सिद्धचर (A. D. 1191)

सिद्धचर (A. D. 1191-210)

सिद्धचर II (A.D. 1210-1247)

Among the Yādava kings of Devagiri or Daulatabad, there were two kings by the name of Singhana. Taking the Singhana mentioned by R. R. S. to be the second, we are required to place the composition of the

work in the latter half of the 13th century. On the whole the R. R. S. may be safely taken to be a work written *about 1300 A. D.*

THE WEIGHT OF AIR.

(By Principal B. N. Seal).

Experiments were of course conducted for purposes of chemical operations in relation to the arts and manufactures, *e.g.*, metallurgy, dyeing, pharmacy, perfumery, cosmetics, horticulture, and themaking of glass (lenses and mirrors of various kinds are mentioned, the spherical, oval—*गुण* and *गुण*, being well-known—Pliny indeed mentions that the best glass ever made was Indian glass). But of Experiment as an independent method of proof or discovery, the instances are rare, I may

note one interesting example in Udayana's *Kirāṇāvalī*, relating to the weight of air. Udayana argues that air must be a distinct and independent *Bhūta*, for if air were made of the Earth-*Bhūta*, it would have weight, and it has none. To prove the absence of weight, he refers to an experiment. A small bladder made of a thin membrane, filled with air, will not cause a greater descent in the scale than the same bladder weighed empty. Hence the air possesses no weight. Then Udayana makes an interesting statement. It may be objected, he says by one who accepts the weight of air—that this argument is inconclusive. For a counter-experiment may be suggested. The balloon filled with smoke (or gas, वायु) rises in the air, whereas the air-filled balloon comes down. This would go to show that air has weight. Udayana replies that this would only show that both smoke (gas, वायु) and air have no weight. The Hindus appear to have been ignorant of the principle of Archimedes, at least as applied to gases. Vallabhaśāharya in the *Līlāvātī* speaks of a peculiar resistance to sinking (or gravity) exercised by water, which explains the tendency in certain objects to float or to come up to the surface of the water but the description shows that he had no clear ideas on the subject. Cf. Udayana, *Kirāṇāvalī*, वायुनिश्चयम् । Cf. also Vallabhaśāharya, *Līlāvātī*.

APPENDIX.

On the Scientific Method of the Hindus.

(BY PRINCIPAL BRAJENDRANATH SEAL.)

The Doctrine of Scientific Method :—A study of the Hindu Methodology of Science is absolutely essential to a right understanding of Hindu positive Science, its strength and its weakness, its range and its limitations. Apart from this rigorous Scientific Method, Hindu Chemistry, such as it is, would be all practical recipe, or all unverified speculation. This, however, would be a very inadequate and indeed erroneous view of this early achievement of the human mind. That the whole movement was genuinely and *positively* scientific, though arrested at an early stage, will appear from the following brief synopsis of the Hindu Methodology of Science.

Criterion or Test of Truth (after the Buddhists) :—The ultimate Criterion of Truth is found not in mere cognitive presentation, but in the correspondence between the cognitive and the practical activity of the self, which together are supposed to form the circuit of consciousness. That knowledge is valid which prompts an activity ending in fruition. Cf. the distinction between *सम्बन्धिज्ञान* and *विसम्बन्धिज्ञान* । Also compare, *समाख्यीकृतविषयौ प्रसिद्धान्तरौ चैवम्* समाख्य—

Vātsyāyana). Truth, the Buddhists contend, is not self-evidence, not the agreement between ideas, nor the agreement of the idea with the reality beyond if any, for this cannot be attained direct, but the harmony of experience (सम्यग्), which is implied when the volitional reaction, that is prompted by a cognition and that completes the circuit of consciousness, meets with fruition, i. e., realises its immediate end (cf. Śrīharsha, Khandana Khanda Khādyā on the relation of सम्यग् to लोकाव्यवहार). This is the material aspect of Truth. The formal aspect is given in a principle which governs all presentations in consciousness, and which combines the three moments of Identity, non-Contradiction and Excluded Middle in every individual cognitive operation (तदुक्तं तन् परिचयनमिदं (identity) अन्वद् व्यञ्जितमिदं (non-contradiction) इतोऽप्यकाराभावे च नृपयति (excluded middle) इति पञ्चममाद्य-व्यापारः—Jayanta, Nyāya-Manjarī, समाधेर्(व्यञ्जितमनम्)]

Perception :—The conditions of perception, and its range and limits, were carefully studied. The minima sensible (e.g., the minimum visible, the Trasarenn, the just perceptible mote in the slanting sunbeam), the infra-sensible (अनुदृश्यान् रश्मि, sometimes termed अतीन्द्रिय the obscured (अनिर्गम, e.g., a meteor in the mid-day blaze), and the potential (अनुदृश्यानि), are distinguished; but finer instruments of measurement were wanting, and this was a principal cause of arrested progress. It may be noted that the measurement of the relative pitch of

musical tones was remarkably accurate and original (*vide* my Paper on Hindu Mechanics and Physics).

Observation (दर्शन—Vāchaspati and Udayana) :—The entire apparatus of scientific method proceeded on the basis of observed instances carefully analysed and sifted. This was the source of the physico-chemical theories and classifications, but in Anatomy, the Hindus went one step further; they practised dissection on dead bodies for purposes of demonstration. Ingenious directions are given, e.g., the body must be first disembowelled and wrapped round with the kusa and other grasses, then kept immersed in still water for seven days, after which the medical student should proceed to remove the layers of the skin with a carefully prepared brush made of the fresh elastic fibres of green bamboos;—which will enable the tissues, vessels and ducts to be observed. *Post-mortem* operations as well as major operations in obstetric surgery (the extraction of the foetus, etc.) were availed of for embryological observations (e.g., it is stated as a result of observation that the rudiments of the head and the limbs begin to appear in the foetus in the third month, and are developed in the fourth; the bones, ligaments, nails, hair, etc. becoming distinct in the sixth);—and also embryological theories, e.g., the indication of sexual character in the second month by the shape of the foetus, the shape of a round joint indicating the male sex, and an

elongated shape as of a muscle the female sex (cf. Charaka, Sūtrasthāna, Chap. IV,— द्वितीये कांसि चनः सन्धयते पिण्डं वेद्यर्चुदं वा । तत्र चनः पिण्डः पुरुषः स्त्री येनैव अर्चुदं नर्पुसकम् । Chakrapāni notes ; चनः कठिनः । पिण्डो घन्याकारः । येनैव दोषमासुषेकाकारः । अर्चुदं अर्चुलीवतम् loc. cit.) In Phonetics (as in the Prātisākhya, circa 600 B. C.), in Descriptive and Analytical Grammar (as in Pāṇini), and in some important respects in Comparative Grammar (as in Chanda's and Hemachandra's Grammars of the Prākṛita Dialects), the observation was precise, minute and thoroughly scientific. This was also the case in Materia Medica, and in Therapeutics, especially the symptomology of diseases. In Meteorology, the Hindus used the rain-gauge in their weather forecasts for the year, made careful observations of the different kinds of clouds and other atmospheric phenomena (*e. g.*, they give the heights of the clouds, the distance from which lightning is ordinarily visible, or the thunder is heard, the area of disturbance of different earth-quakes, the height to which the terrestrial atmosphere extends, etc., *vide* Varāhamihira, Śrīpati, and the authorities quoted by Utpala). In Astronomy, the observation was, generally speaking, very defective as in the determination of the solar and the planetary elements, and this was probably due to the lack of practical interest, but the determination of the lunar constants entering into the calculation of lunar periods and eclipses, matters in

which the Hindus had a practical ceremonial interest, reached a remarkable degree of approximation (much above Greco-Arab computations) to the figures in Laplace's Tables, which can only be explained by the circumstance that in the case of these constants the Hindus carried out for more than a thousand years a systematic process of verification and correction by comparison of the computed with the observed results (like the navigator's correction of the course of the ship at sea), a process which was termed *संश्लेषण*. In Zoology, the enumeration of the species of Vermes, Insecta, Reptilia, Batrachia, Aves, etc., makes a fair beginning, but the classification proceeds on external characters and habits of life, and not on an anatomical basis. In Botany, the observation was mainly in the interests of *Materia Medica*, and the classification was as superficial as possible. (*Vide* my paper on the Hindu Classification of Plants and Animals).

Experiments :—Experiments were of course conducted for purposes of chemical operations in relation to the arts and manufactures, *e. g.*, Metallurgy, Pharmacy, Dyeing, Perfumery and Cosmetics, Horticulture, the making and polishing of glass (lenses and mirrors of various kinds are mentioned, the spherical and oval *वृत्त* and *वर्तुल*, being well-known—Pliny indeed mentions that the best glass ever made was Indian glass). And the

results of such experiments were freely drawn upon for building up scientific hypotheses and generalisations. But of experiment as an *independent* method of proof or discovery, the instances recorded in books are rare. I may note one interesting example in Udayana's *Kiraṇāvali*, relating to the weight of air. Udayana argues that air must be a distinct and independent *Bhuta*, for if air were a form of the Earth-*Bhuta*, it would have weight, and it has none. To prove the absence of weight, he refers to an experiment. A small bladder made of a thin membrane, filled with air, will not cause a greater descent in the scale than the same bladder weighed empty. Hence the air possesses no weight. Then Udayana makes an interesting statement. It may be objected, he says, by one who accepts the weight of air—that this argument is inconclusive. For a counter-experiment may be suggested. The balloon filled with smoke (or gas, *वृक्ष*), rises in the air, whereas the air-filled balloon comes down. This would go to show that air has weight. Udayana replies that this would only show that both smoke (or gas, *वृक्ष*) and air have no weight. The Hindus appear to have been ignorant of the principle of Archimedes. Vallabhāchāryya in the *Līlāvati*, it is true, speaks of a peculiar resistance to sinking (or gravity) exercised by water, which explains the tendency in certain objects to float

or to come up to the surface of the water, but the description shows that he had no clear ideas on the subject.

Mathurānātha, again, states that the determination of the degree of purity (the carat) of gold by rubbing against the assaying stone and observing the character of the yellowish streak against the black smooth background, is only an indirect means of ascertaining weight (गुरुत्वज्ञपन lit. specific gravity) —which seems to suggest that there was a more direct means of arriving at the latter. Probably this refers to the common Indian method of comparing the lengths and weights of wires of uniform thickness that can be formed by drawing different pieces of gold through the same diamond bore. I think it may be regarded as fairly certain that the Hindus were ignorant of Archimedes's discovery, an ignorance which, at any rate, they could not have well borrowed from the Greeks, no more than they could have thus borrowed their knowledge of things unknown to the Greeks themselves. [Cf. Udayana, *Kiraṇāvali* :—

वाङ्मनिरूपयन्, किं च (वाकीः) दृष्टिमीले गुरुत्वमपि ज्ञात् । न च
पथनापूरितस्य यन्मोष्टकादौः अपूरयद्वातः अधिकं यत्नमनन् । सरीय-
मानस्य धूमापूरितेन हृदम् यन्मैकानिकं इति चेत् । न । अर्धं धूमद्वयायां ।
तदापि क्षरिमापयेवद्वेतीरवततिविस्मयस्य अपतीतिः ।—cf. Vallabhā-
chāryya, *Līlāvati*—गुरुत्वविशेषेऽपि पाषाणान्नाह्वयमस्ति । कल्पमो-
क्षज्जल निधनम् अदृष्टद्वेष्टकताः स्यादपि पतनोत्पत्तन-निधनो भविष्यतीति ।

चेत् न । लक्षाधीनम् कलित धारय पतनप्रतिबन्ध सम्पन्नम् एतच्च
जलम् योदस्य कस्यचिद्विष पतनप्रतिबन्धकानर्थक्यम् । इष्ट हेतुकमेव सञ्चरत्य
उन्मत्तमस्य]—cf. Mathurānātha, सन्निकर्षव्युत्तरद्वय on Gan-
gūssa's Tattvachintāmaṇi—तस्य (निक्षयीपलस्य) न सुवर्ध-
यीतामित्यस्य कत्वं किन्तु यौतव्यादा नृकलमेव लक्ष्यमस्य कलमेव तस्य ।

Fallacies of Observation—Mal-observation and Non-observation :—These were carefully studied in relation to errors of observation, and Hallucination (यस्य अध्यास, आदीप्य)—which were ascribed to three causes :—(a) Dosha, दोष, defect of sense organ, as of the eye in jaundice, or of the skin in certain forms of leprosy (leading to tactile insensibility, cf. Susruta) or defect of necessary stimulus, e.g., too faint light, or undue distance or nearness, in vision ; (b) Samprayoga, सम्प्रयोग, presentation of a part or an aspect instead of the whole ; and (c) Sanskāra, संस्कार, the disturbing influence of mental predisposition, e.g., expectation, memory, habit, prejudice, etc.

The Doctrine of Inference :—Anumāna (Inference) is the process of ascertaining, not by perception or direct observation, but through the instrumentality or medium of a mark, that a thing possesses a certain character. Inference is therefore based on the establishment of an invariable concomitance (Vyāpti, व्यप्ति) between the mark, and the character inferred. The Hindu Inference (Anumāna) is therefore neither merely formal nor merely material, but a combined Formal-Material

Deductive-Inductive Process. It is neither the Aristotelian Syllogism (Formal-Deductive Process), nor Mill's Induction (Material-Inductive Process), but the real inference which must combine formal validity with material truth, inductive generalisation with deductive particularisation.

An inference admits of a rigorous formal statement,—in the shape of five propositions, for dialectical purposes (i.e., in demonstrating to others), or of three propositions when the inference is for one-self (सापदिनान्):—(1) the probandum, the statement of the proposition to be established (प्रतिज्ञा, साध्यनिर्दिष्ट, e.g., yonder mountain is fiery (say, an active volcano); (2) the reason, the ascription of the mark (हेतु, निश्चयप्रदहेतु)—e.g., for it smokes; (3) now, the general proposition, stating the invariable concomitance which is the ground of the inference,—elencbed by an example bringing home the responsibility of the reasoner to establish a real relation, e.g., whatever smokes is fiery, as an oven; (उदाहरण);—(4) next, the application, the ascertainment of the existence of the mark in the present case (उपपन्न) e.g., yonder mountain smokes;—(5) finally, the conclusion, the probandum proved (निगमन), e.g., yonder mountain is fiery.

1. Yonder mountain is fiery.
2. For it smokes.
3. Whatever smokes is fiery, as an oven.

4. Yonder mountain does smoke.

5. Therefore, yonder mountain is fiery.

For inference for oneself, only the first three or the last three propositions, are held to be sufficient.

The Hindu Anumāna, it will be seen, anticipates J. S. Mill's analysis of the syllogism as a material inference, but is more comprehensive;—for the Hindu Udāharana, the third or general proposition, with an example, combines and harmonises Mill's view of the major premise as a brief memorandum of like instances already observed, fortified by a recommendation to extend its application to unobserved cases, with the Aristotelian view of it as a universal proposition which is the formal ground of the inference. This Formal-Material Deductive-Inductive process thus turns on one thing—the establishment of the invariable concomitance (समिति) between the mark and the character inferred,—in other words, an inductive generalisation. The question is—what is our warrant for taking the leap from the observed to unobserved cases? Under what conditions are we justified to assert a Universal Real Proposition on the basis of our necessarily limited observation?

The Chārvāka view :—Among the Chārvākas there were two classes, the cruder school of materialists who accepted perception (स्पर्श) as a valid source of knowledge, as well as the reality of

Natural Law (स्वभाव), and the finer school of sceptics, who impugned all kinds of knowledge, immediate as well as mediate, and all evidence, Preception as well as Inference, *vide* Jayanta's reference in the Nyāya-Manjarī to ह्यविहितवर्णाकारः; also चार्वाकपुत्रेण स्वभावतस्तु व्याख्यास्यान इति इतिहास इत्यादिप्रमाणैश्च व्याख्यातवान्—Añhuika I, Manjarī.

The Chārvakas hold that the principle of causality, which the Buddhists assume to be a ground of an induction (व्यप्ति) is itself an induction (a case of Vyāpti), which amount to reasoning in a circle (चक्रक); that every inference is based on an unconditional invariable concomitance which itself must be inferred, as universal propositions cannot be established by our limited preceptions, and thus there is a regressus ad infinitum (अनन्तरि परम्पर); and that the nexus between cause and effect, or between the sign and the thing signified (e.g., smoke and fire) is only a mental step or subjective association based on former perception, a mental step which by accident is found justified by the result in a number of cases.

The Buddhists—their Analysis and Vindication of Inference:—The Buddhists, however, take their stand on the principle of the Uniformity of Nature (प्रतिवन्ध, स्वभाव प्रतिवन्ध, Nyaya-Vindu). This uniformity, for scientific purposes, has to be divided into two different relations,—(1) the uniformity of succession in the relation of cause and effect, e.g.,

of smoke to fire (धूमनिमित्तवृक्ष, बह्वर्थादि, Nyaya-Vindu); (2) the uniformity of co-existence (in the form of co-inherence in the same substrate) in the relation of genus and species, *e.g.*, the relation of invariable concomitance expressed in the proposition,—all Sinsapās are trees,—which is not a relation of causality, but of co-existence or co-inherence in the same substrate (*i.e.*, the co-inherence of the generic qualities of a tree with the specific characters of a Sisu tree, in this particular individual before me, a Sisu tree),—a relation which may be termed essential identity (वैशिष्ट्य, स्वभाव—Nyaya-Vindu). To these two, the Buddhists add a third ground of inference, non-perception of the perceptible (अनुपपत्ति, दृष्टानुपपत्ति), which is employed in inferring the absence (अभाव) of a thing from the non-perception of something else. In all cases of inference based on the Uniformity of Nature, the relation is that of inseparableness or non-disjunction between the mark and the character inferred. The question is—how is this inseparableness (वैशिष्ट्य) ascertained, and what is the warrant of our belief in it, in these cases?

Ascertainment of Inseparableness or Non-disjunction: Buddhist Account:—First take the case of causation. The cause is the invariable antecedent of the effect. What is meant is that the specific effect (with all the distinctive and relevant accompaniments, धर्मविवेच) is invariably preceded by a

specific cause (कारणविधि). It is not that clouds always lead to rain, or that floods in the river valley always imply rain in the hills higher up. But this particular conjunction of antecedent circumstances (e.g. the appearance of a particular kind of clouds accompanied with flashes of lightning, the roll of thunder and flights of Valakás—driven by the wind from a particular quarter of the horizon, and ascending in black masses, etc.) is as a rule the precursor of a particular assemblage of rain effects (rain with particular accompaniments). Again, this particular kind of flood (overflowing of the river banks accompanied with muddy discoloration of the water, rapid currents, the bearing down of tree trunks, etc.) is always preceded by rain in the hills higher up (though, no doubt, other case of floods in a river may be due to a breach in an embankment or the melting of the snows). In other words, the Buddhists (and the earlier Nyāya Schools) avoid the difficulty arising from the plurality of causes by taking into consideration the accompanying phenomena, which, if properly marked, would always point to a specific cause of a specific effect.

I quote Nyāya authorities, but this device to obviate the plurality of causes is common to the early Nyāya and the Buddhistic systems.

पूर्ववत् । यच्च कारणेन कार्यमनुमोचते । सदाहरणम्—

मैत्रीप्रिया मविष्यति अटिरिति कारणेन कार्यानुमानम् । कथं

पुनरस्य प्रयोगः । इष्टिमलः एते मेघाः गन्धोरज्ज्वलितवस्त्रे सति बहुमहाका-
रत्वे सति अचिरप्रभावात् सति सन्नतिमलान् इष्टिमलमेव वदन् ।

श्रीधरन् (यत्र कार्येषु कारणमनुमीयते)—उदाहरणम्—

उपरिर्दृष्टमहं हस्तस्थिनी नदीसीतः शीघ्रमे सति पूर्वसज्जकाहादि-
वस्तुवस्त्रे सति पूर्वज्ञान् पूर्वइष्टिमलदीवदिति । (Uddyotakāra,
Chap I. Āhnikā 1, Sūtra 5). Vāchaspati puts this
clearly :—यद्यपि कारणमाले व्यभिचरति कार्योत्पादं तथापि यद्वयं
न व्यभिचरति तत्र किदुपेन प्रतिपत्ता भवितव्यम् । अन्वया धूमनाशमपि वस्त्र-
महा व्यभिचरतीति न धूमविशेषो गतको भवेत् । In other words,
a single condition called a cause is not invariably
succeeded by the effect, nor does the effect
phenomenon in general point to any particular
cause as antecedent, for there may be a plurality of
causes of a general effect. The skilful observer
will therefore select the full complement of
causal conditions, which is invariably succeeded by
the effect,—and also the specific effect (e.g., धूमविशेष)
which points to a specific causal antecedent.
Compare also Jayanta :—we infer an effect from a
specific assemblage of causes—न च कारणमालस्य हेतुत्वं दूमी
वेनास्य व्यभिचारः स्यात् । अपि च विभिष्टमेव कारणं हेतुः । न च
कारणविशेषो दुरवगमः । गन्धोरज्ज्वलितारम्भित्विगिरिगङ्गराः रोज्ज्व-
गवत्स्थान्तमालमलिनस्त्रि...इष्टिं व्यभिचरन्तीह नैव प्रायः पक्षीमुचः ।
अननुपपत्तेरप्येवमनुमानस्य औचित्यम् । न स्यादूनविशेषाद्यामपि दीदृश-
मङ्गितः । Similarly we infer a specific cause from
a specific assemblage of effects :—इवमिति यत्र कार्येषु

कारणमनुमीयते यथा नदीपूरेण सपरितने द्रव्ये हातरिति । इष्टिमत्-
 पृष्ठद्वयसंघाट । इह नदी केनिलकलुषत्वादिविभिन्नपूरोपेतत्वात् । यत्
 तेनमद्विभक्तविलगनादिनापि नदीपूरोपपत्तिर्ह'या इति तथापि 'सत्यते—

इमा तु रपराधीत्यं विनिर्दं यो न पश्यति ।

नानुमानस्य दोषोऽसि प्रमेयाव्यभिचारिणः ॥

(*Nyāya-Manjarī*, A'hnikā 2, on Gotama Sūtra
 5, A'hnikā 1, Chap I.)

A specific assemblage of causes, therefore, has only one specific assemblage of effects, and *vice versa*. Of course, the observer is to find out the essential or relevant features (as distinguished from the irrelevant ones) which, being included, will enable him to specify the particular cause of the particular effect.

Now this being premised to be the exact meaning of the inseparableness or non-disjunction in the case of cause and effect, we come to the question with which we started—how is this relation to be ascertained or established between two phenomena or assemblages of phenomena? Obviously, mere observation of their agreement in presence (*सम्यक्*) and their agreement in absence (*व्यतिरेक*) is no help in the matter. Take a concrete example. The ass is customarily employed to bring the fuel with which fire is lighted. In a hundred cases you have observed the ass among the antecedents of smoke. In a hundred cases you may have observed that when there is no ass, there is no smoke. This is no

warrant for concluding a relation of cause and effect between an ass and smoke. It may be that you happen to have never observed smoke without an antecedent ass, or an ass without smoke following. Even this is of no avail. It is not agreement (unbroken and uniform, though it be) in presence, or in absence, or in both, that can settle the matter. There is one and only one way of ascertaining the causal relation. Suppose *A* with certain accompaniments is found to precede *B* immediately. Now if *A* disappearing, *B* disappears, even though all other antecedents remain and there is no other change in the case, then and then only can the causal relation be ascertained. It is not a mere table of positive instances or negative instances (चदर्शनाच्च न दर्शनात्);—it is this method which we may term the Method of Subtraction (the Method of Difference in its negative aspect) that is the only exact and rigorous scientific Method. Such was the statement of the earlier Buddhists (cf. Uddyotakāra's and Vācaspati's report of the Buddhist Doctrine of Inference—स हि प्रतिबन्धो न दर्शनमात्रावस्यैः ।

तस्मात् तादात्म्यादनुत्पत्तिरिवत्सकः एव प्रतिबन्धः । यदाह कार्यकारण-
भावादा सभावादा निरासकान् । अविनाभावनिवर्ती(दर्शनाच्च न दर्शनात्
—a Buddhist *Kārikā* quoted in Vācaspati, Udayana, Śrībharaṇa, Mādhyama, etc.)—कार्यकारणभावश्च यदनु—अस्मिन्
कृति भवति—सदसु अपि तदस्यैव अस्मिन्नस्ति न भवति—एवमाकारः ।
न अन्वयव्यतिरेकाभ्यामतिरिच्यते ।... (एवं तादात्म्यामपि विपरीतं वाचक

प्रमाणोपपत्त्या निश्चेदन्त्यम् ।...तस्मात् तादात्म्यजनद्वयनिष्ठासिद्धिर्ब्रह्मनिश्चयो
नात्यतः ।—Vachaspati, Tātparyyalīkā, Chap I, A'hnika
1, Sūtra 5, अनुमानलक्षणे—आदिपक्षोपायः ।)

But the canon in this form is not sufficiently safe-guarded against possible abuse. Two points have to be emphasised :—(1) It must be carefully observed that no other condition is changed, (2) that the appearance and disappearance of *A* must immediately precede the appearance and disappearance of *B*. The definition of a cause is based on two fundamental characters, (1) the unconditional invariableness of the antecedence, and (2) the immediateness of the antecedence. The canon of the Method of Difference must therefore be stated in such a form as to emphasise each of these aspects. And one main difficulty in the practical application of the canon is that along with the introduction or sublation of an antecedent, some other phenomenon may be introduced or sublated unobserved. As a safe-guard against this radical vitiation of the Method, the later Buddhists formulated the canon of a modified Method, termed the *Panchakārami*, a Joint Method of Difference, which combines the positive and the negative Methods of Difference (the Method of Addition and the Method of Subtraction) in a series of five steps, and which equally emphasises the unconditionality and the immediateness of the antecedence as essential moments of the causal relation. This is

neither agreement in presence, nor agreement in presence as well as absence (the foundation of J. S. Mill's Joint Method of Agreement), but the Joint Method of Difference. The Panchakārani runs thus :—

The following changes being observed, everything else remaining constant, the relation of cause and effect is rigorously established :—

First step—The 'cause' and the 'effect' phenomena are both unperceived.

Second step—Then the 'cause' phenomenon is perceived.

Third step—Then in immediate succession, the 'effect' phenomenon is perceived.

Fourth step—Then the 'cause' phenomenon is sublated or disappears.

Fifth step—Then in immediate succession, the 'effect' phenomenon disappears.

Throughout, of course, it is assumed that the other circumstances remain the same (at least the relevant or material circumstances).

This Panchakārani, the Joint Method of Difference, has some advantages over J. S. Mill's Method of Difference, or what is identical therewith, the earlier Buddhist Method; and the form of the canon bringing out in prominent relief the unconditionality and the immediateness of the antecedence, is as superior from a theoretical point of view to J. S. Mills's canon,

and is as much more consonant than the latter to the practice of every experimenter, as the Hindu analysis of *Anumāna* as a Formal-Material Deductive-Inductive Inference is more comprehensive and more scientific than Aristotle's or Mill's analysis of the Syllogism (or Mediate Inference).

But even the *Panchakārani* is no sufficient answer to the question with which we started. The *Panchakārani* is only a method ; it shows only how in a particular case the relation of cause and effect is to be established (*सम्यक्प्रमाणम्*). But we want more than this—we require a warrant for the process. The Buddhists therefore supply the following proof of the Method :—Doubt is legitimate, but there is a limit to doubt. When doubt lands you in an unsettlement of a fundamental ground of practice, and would thus annul all practical exercise of the will, the doubt must cease ; else the doubt would be suicidal or sophistical. In this particular case, when the *Panchakārani* is satisfied, the antecedent in question must be the cause, for there is no other antecedent to serve as cause ; the proof is indirect but rigid. If this be not the cause, there is no cause of the phenomenon. It was not, and it begins to be, without a cause ; which would be a contradiction of the rational ground of all practice, for all volitional activity proceeds by implication on the principle of causality. If things could happen

without a cause, all our motives to action would be baffled. The link between a presentation and the instinctive volitional reaction would snap, and the circuit of consciousness would be left incomplete. In fact, the Buddhists go further; they hold causal efficiency (कारणत्वम्) to be of the essence of empirical (relative) Reality. The proof of the Joint Method of Difference, then, lies in a strict application of the principle of causality in its negative form (viz., there can be no phenomenon without a cause) and the truth of this last is guaranteed by the same ultimate criterion of empirical (relative) Reality as the truth of Perception itself, viz., the correspondence between the rational and the practical activity of the self.

But invariable concomitance (or non-disjunction), the Buddhists argue, has another form, e. g., the relation of the genus to the species. We may have perceived a hundred instances of the association of certain characters with certain others; we may also have never perceived the former when the latter are absent, but this would not enable us to generalise and establish invariable and unconditional co-existence. We must be first satisfied that there is identity of essence (आद्यत्वाद्भावात्). It is only when we perceive that the characters of a *Sinsapá* are co-inherent with the generic characters of a tree in the same individual object (a *Sinsapá* tree before me), and when we further

perceive that the characters are held together by the relation of identity of essence, that we can say that all Sinsapā are trees. For as there is identity of essence, a Sinsapā would not be a Sinsapā, if it were not a tree. It would lose its self-identity which is a contradiction. Hence the relation of identity of essence (तादात्म्य सम्बन्ध), as in the relation of the species to the genus, is the sole ground for establishing uniformity of co-existence (पतित्वम्, सम्भाव्यतित्वम्).

(For the Buddhist Method of Induction, in its later form, the Panchakāraṇi, vide Sarvadarsana Saṅgraha—Buddhist reply to the Chārvāka attack on Inference :—

यदव्यवधानि अविवक्षाभावी दुर्बोधि इति तदसंशयीयः । तादात्म्यतदनु-
पत्तिव्याप्तविलाभावरत्नं सुप्रज्ञानत्वात् । तदुक्तं—कार्यकारणभावात् वा
सम्भावत्वात् वा नियामकत्वात् । अविवक्षाभावनियमोद्दर्शनाच्च न दर्शनात् ।
As for the Nyāya view अव्यवधानिरेको अविवक्षाभावनियमव्यवधानी
इति ।—the Buddhist objects—ननु पक्षे साध्यसाधनयोरव्यभिचारी
द्वारवधारणः भवेत् । भूते, भविष्यति, वर्तमाने अनुपलभ्यमाने च व्यभिचार-
ग्रहाया व्यभिचार्यत्वात् ।—the Nyāya retorts ननु तथापि चक्षुष्ये
तावकैरेव मते व्यभिचारग्रहा दुष्परिहारा इति ।—the Buddhist
answers—सर्वं बोधः, विज्ञाति कारणं कार्यमुत्पद्यमानं इत्येवं-
विधायाः ग्रहायाः व्याघातानधिकतया निहतत्वात् । तद्वै हि
आश्चर्येण यजिष्ठाग्रहमने व्याघातादयः नावतरन्तुः । तदुक्तं व्याघाता-
वधिपश्यत्वा इति । तस्मात् तदनुपत्तिनिवर्तकं अविवक्षाभावी नियोज्यते ।
तदनुपत्तिनियमश्च कार्यहेतोः । अथर्चोपलभ्यानुपलभ्यवस्तुनिवस्तुनः ।

कार्यस्य लक्षणेः प्राक्पक्षः, कारखीपक्षयोः कति उपपक्षः, उपपक्षस्य पक्षान् कारखानुपपक्षान् लक्षणेः इति पक्षकारख्या घुम-घुमभ्रजयोः कार्यकारपक्षः निरूपयति । तथा तादात्म्यानिर्देशेन अपि अविनाभावः निरूपयति । यदि शिशवा हस्तलम् अतिपतेत् साक्षात्तमेव लक्ष्णम् इति विपक्षे बाधकमर्थः । अत्रर्त्ते तु बाधके भूयः सङ्भावोपपक्षोऽपि व्यभिचारशङ्कायाः को निवारयिता । शिशवाहस्तलोच तादात्म्यानिर्देशः ह्योऽर्थं शिशवा इति सामानाधिकरण्यात् उपपद्यते । तथान् कार्य-
क्षानी कारखम् आकाशम् अतुमापयत इति सिद्धम् । *Sarvadaršana Sangraha, Bauddha-Darshanam Vide also Sridhara Kandali.*

The Nyāya Doctrine of Inference :—The Nyāya easily demolishes the Buddhist contention about identity of essence. The Nyāya writers, being realists, do not impugn the reality of the genus (कति) like the nominalists or the nominalistic conceptualists ; but they point out that the inseparableness (or non-disjunction) in such cases can only be established by the experience of unbroken uniformity (व्यभिचारित्वे i.e., by अन्वयव्यभिचारी, दर्शनादर्शने). Uniform agreement in presence with uniform agreement in absence,—not the mysterious identity of essence irresistibly perceived in any individual case or cases—is the only basis for constituting genera and species in Natural Classification. Indeed some of the later Nyāya writers point out that individuals do not always possess in Nature all the characters that go to form the definition of the class to which they are referred.

Similarly, as regards the relation of cause and effect, a *nexus* is sometimes fancied to be perceived, a power in the cause to produce the effect (*शक्ति*), or an ultimate form (*शक्ति बीजा*), which is supposed to be present, whenever the effect (quality or substance) is produced (cf. Bacon's view of the 'Forms' of Simple Qualities). All this is neither a matter of observation nor of legitimate hypothesis. There is nothing except the invariable time-relation (antecedence and sequence) between the cause and the effect. But the mere invariableness of an antecedent does not suffice to constitute it the cause of what succeeds ; it must be an unconditional antecedent as well (*अव्यवहितपूर्वक निवृत्तपूर्वक-वर्तिता* , being the definition of *कार्यकारणभाव*). For example, the essential or adventitious accompaniments of an invariable antecedent, may also be invariable antecedents, but they are not unconditional but only collateral and indirect, in other words their antecedence is conditional on something else (*न सातन्त्र्येण*). The potter's stick is an unconditional invariable antecedent of the jar, but the colour of a stick, or its texture or size or any other accompaniment or accident, which does not contribute to the work done (so far as we are considering it) is not an unconditional antecedent, and must not therefore be regarded as a cause. Similarly, the co-effects of the invariable antecedents, or what enters into the production of these

co-effects, may themselves be invariable antecedents but they are not unconditional, being themselves conditioned by those of the antecedents of which they are effects. For example, the sound produced by the stick, or by the potter's wheel, invariably precedes the jar, but it is a co-effect,—and *A'kāśa* (ether) as the substrate, and *Vāyu* (air) as the vehicle, of the sound, enter into the production of this co-effect, but these are not 'unconditional' antecedents, and must therefore be rejected in an enumeration of conditions or causes of the jar. Again, the conditions of the conditions, the invariable antecedents of the invariable antecedents, are not unconditional. The potter's father is an invariable antecedent of the potter who is an invariable antecedent of the jar, but the potter's father does not stand in a causal relation to the potter's handiwork. In fact, the antecedence must not only be unconditionally invariable, but must also be immediate (अव्यवहितपूर्वकालावच्छेदित कार्यक्षेत्री सत्त्वम्). Finally, all seemingly invariable antecedents which may be dispensed with or left out, are *ipso facto* not unconditional, and cannot therefore be regarded as causal conditions; in short, nothing that is unnecessary is unconditional; for this class, *vide* Visvanātha—निदलावच्छेदकपूर्वकभावितः अव्यवहितपूर्वकालावच्छेदित एव कार्यक्षेत्री । तद्विदम् (अतिरिक्तं) असम्बाधितं—Visvanātha, *Siddhānta Muktaṃvali*, on Sloka 20. For example, it is the custom to point to spatial position or direction with the

fingers, but finger-pointing, though invariably present, is not causally related to the perception of direction or spatial position, because we can imagine such perception without finger-pointing, (अन्यथाविहितस्य अकृत्या निर्देशस्य दिग्दर्शकत्वेन न स्वाभाविकः सम्बन्धः, Vāchaspathi, Tātparyya-Tikā, Chap. I, A'hnikā 1, Sūtra 5,—this shows that the doctrine of अन्यथाविहितस्य was long anterior to Gangesa).

[Visvanātha in the Bhāṣya-Parichechheda mentions five kinds of अन्यथासिद्ध, conditional antecedents—(1) यत्र सङ्गपूर्वभावाः (2) यस्य सा कारकभादाय (पूर्वभावाः), (3) अन्तर्गति पूर्वभावे ज्ञाते यत्पूर्वभावविज्ञानम्, (4) जलकं प्रति पूर्ववर्तिताम् अपरिज्ञातं यस्य (पूर्ववर्तिता) न गच्छते, and (5) अथापि यत् निवृत्तावयवकपूर्वभावविनः प्रतिरिक्तम् भवेत् (एतेषु पञ्चषु चावयवकस्यो—Slokas 19. and 20), यस्य स्वातन्त्र्येण अन्यव्यतिरेकी न साः किन्तु स्वकारकभादादेव अन्यव्यतिरेकी गृह्यन्ते सदन्यथासिद्धम्, Siddhānta Muktāvali, loc. cit.—The Dinakari points out that the first two cases are comprehended under the formula उत्तरान्वयव्यतिरेकव्युत्पत्त्यन्यव्यतिरेकशालिनम्. There are several classifications of these irrelevant antecedents (अन्यथासिद्ध); I quote one of the best known].

The unconditional (अन्यथाविहितस्य) as interpreted in this comprehensive sense is a far more fruitful conception than Mill's, and is well adapted to its work—the elimination of the irrelevant factors in the situation. In the end, the discrimination of what is necessary to complete the sum of causes, from what

is dependent, collateral, secondary, superfluous or inert, (i. e. of the relevant from the irrelevant factors) must depend on the test of expenditure of energy. This test the Nyāya would accept only in the sense of an operation analysable into molar or molecular motion (परिसङ्ग एव भौतिको व्यापारः करोत्यर्थः—चरौन्दिवस्तु व्यापारी नास्ति, Jayanta, Manjarī, A'hnika I); but would emphatically reject, if it is advanced in support of the notion of a mysterious causal power or efficiency (शक्ति). This is a peculiarity of the Nyāya—its insisting that the effect is only the sum or resultant of the operations of the different casual conditions—that these operations are kinetic, being of the nature of motion, in other words holding firmly to the view that causation is a case of expenditure of energy, in the kinetic form,—but at the same time absolutely repudiating the Sāṅkhya conception of power or productive efficiency as metaphysical or transcendental (चरौन्दिव), and finding nothing in the cause other than an unconditional invariable complement of operative conditions (कारकसमयौ) and nothing in the effect other than the consequent phenomenon which results from the joint operations of the antecedent conditions (समुद्गतसकलकारकानिकरः परिसङ्ग एव—Jayanta—सामयौ कार्ये—सामयौकार्यत्वे तु कार्यसमस्तु किमनरात्मनोर्नया यत्ना—Jayanta, *ibid*, A'hnika, I, शक्तिविराकरवस्तु—it may be noted that the Nyāya, while repudiating transcendental power (Sakti) in the mechanism of nature

and natural causation, does not deny the existence of metaphysical conditions like merit (*पुण्य*) which constitute a system of moral ends that fulfil themselves in and through the mechanical system and order of Nature—*vide* Jayanta. अतोन्द्रियं किमपि कारणं कश्चित्मेव पुण्यंदि—A'hnika 1, अह्निकविचारकम्).

The causal relation, then, like the relation of genus to species, is a natural relation of concomitance (*व्यतिः सामाधिकः समस्यः*—Vāchaspati) which can be ascertained only by the uniform and uninterrupted experience of agreement in presence and agreement in absence, and not by deduction from a certain *a priori* principle like that of Causality or Identity of Essence.

Nyāya objection to the Buddhist Method of Difference as a means of ascertaining causality.

Take for example the Buddhist deduction of Causality in any particular conjunction by means of the negative Method of Difference, or of the Panchakārani. The ascertainment of the causal relation by these Methods is open to the following objections :—(1) The unconditionality of the antecedent cannot possibly be ascertained. As the Chārvāka rightly points out, the Methods enable you to eliminate irrelevant antecedents that are or can be perceived ; but the introduction or sublation of latent or undetected antecedents can be imagined against which the Method of Difference is powerless. In the case of the production of

smoke, for example, by fire,—what if I say that an invisible demon intervenes in every case between the fire and the smoke, that this demon (देव) is the immediate antecedent and real cause of the latter, and that the fire is an accident which, in every such case, is brought about by its own causal antecedents ;—in saying this, I do not go counter to the principle of causality and am landed in no contradiction (विरुद्ध) such as strikes at the very roots of all practice, or baffles the completed circuit of consciousness, however much I may violate probability.

(2) In the second place, even supposing that the fire, in this particular case (which satisfies the Method of Difference rigidly) is ascertained to be the cause of the smoke, how can I know that fire is the cause in other cases, or that there is no other cause. You will perhaps argue that if there were an *indefinite* number of causes of the same specific phenomenal effect, it would violate the principle that phenomena are all conditioned, i.e., exist only under certain conditions (कारणविकल्प),—which is more comprehensive than the principle of causality, and the contradiction of which equally overthrows all rational practical activity. Yea, I accept the conditionality of phenomena, but this is not violated by supposing that one specific assemblage of phenomena has more than one cause. It is true that if you suppose such plurality of causes, you cannot establish the invariableness of

the particular conjunction (green-wood fire and smoke) which your Method of Difference fixes upon as a case of cause and effect ; in other words, with your special principle of Causality so restricted, and without any general principle of Uniformity of Nature to fall back upon, you cannot ascertain, from the present case, or from any number of similar cases that you may have observed, that all green-wood fires are followed by smoke ; i.e., you are helpless in demonstrating with apodictic certainty (or ascertaining indubitably) the relation of cause and effect. But this is an objection against your own position, not mine. Why not admit at once that certain phenomena are naturally connected (as invariable concomitants or antecedents) with other phenomena, and take your stand on observed concomitance (uniform and uninterrupted experience of agreement in presence as well as absence) without assuming causality as an *a priori* principle and making deductions therefrom, and without the trouble of ascertaining the relation of cause and effect in every individual case. I am free to admit that theoretical objections of irresistible force (like those of the Chárváka Sceptics) can be urged against this ascertainment of universal invariable and unconditional concomitance (*व्यभिचारीत्वम्*) on the basis of mere observation. Doubts of this kind can no more be laid by my view of the matter than by your canons of causality and essential

identity (तदुत्पत्ति and तादात्म्य). Ultimately we all have to fall back on the rational practice of thinking persons (प्राज्ञावन्तः), and such persons are always content to act on practical certitude instead of hankering after an unattainable apodictic certainty in the affairs of life (ग्रन्थाधिकारीकदावासनुपासयता सदादर्शनं गृह्णीयन्). This same practical certitude is also the ultimate warrant of the Deductive-Inductive Inference by which we ascertain the characters of things without direct perception and through the medium or instrumentality of a mark.

[To the earlier Buddhist canon of the Method of Subtraction, i. e., the negative Method of Difference, Uddyotakara and Vāchaspati of the Nyāya School pertinently and acutely object as follows :—

सत्यं यत् किञ्चित् कञ्चित् दृष्टं तस्य यत्र प्रतिबन्धः, तदिदं तस्य तत् समकं तत्र इति अनुमानोक्तः । स एव तु प्रतिबन्धी न तावत् तदुत्पत्त्या सम्भवति । आ दुर्गरियं तदुत्पत्तिः । धूमस्य किं वक्रानन्तरं भावः । स तादृशः अस्ति रासभस्यापि । तत्प्रतिबन्धोऽपि धूमः स्यात् । अयं तदनन्तरमेव भावः, न च रासभावनन्तरं भवदपि तदनन्तरमेव भवति. तस्मिन् सति अपि असति अग्री तदभावात् । असति अपि तस्मिन् सत्यादौ भवति वग्री तदभावात् । अयं यद्यपि धूमस्य बहिर्भावादुपिधानं ततोपलब्धं, तथापि देहाकारादिषु तदभावीऽस्य कुतश्चः । तथा हि भूमी सूयो रासमे दृष्टे धूमी दृष्टः, तदभावे च अदृष्टः, न स तत्कार्यः । तज्जातीय-स्यैव धूमस्य रासमं विना सति वग्री भावात्, एवं सत्यपि अग्री पित्राचैनं जनिषी धूमः, कश्चिद्देहादौ तज्जातीय एव रासमेवदवदुभावीऽपि पित्राचा-देव भविष्यति, इति 'अवयव' शब्दया भाव्यं निदानकम् अप्रकृतम् । न च सति

भावात्मात्रं निवृत्तकं, तस्य रासमादिषु अवशिष्टात् । तदनन्तरमेव इति च अवधारणस्य यत्तायामभावात् । अवधारणेन तु यत्तापनयने परस्परवृत्त-
प्रसङ्गात् ।

Buddhist reply :—सादेतत् । यो यो धूमो हतः स सर्वसावत्
आदेत्यनवहितवृत्तान्तरमेव, न विद्यान्तान्तरं । स च कादाचित्कतया
निमित्तमपेक्षमायी यदनन्तरमेव गम्यते तदेव अद्यतीतव्यभिचारं निमित्तं
करोति, न तु प्रतीतव्यभिचारं रासमादि । नापि सर्वथाऽनुपपन्नविद्या-
आदिः । यदि न तादृशितं कस्यात् विद्यापि बहिर् कश्चित् धूमो न उद-
जम्यते । अथ असौ (विद्याः) सत्त्वेना बहिर्बुद्धितः तदा सति आदेत्यन-
वत् कार्यं बहुरपि न कारणम् । कारणं चेत् कथं तदनन्तरं धूमभावप्रका ।
Now the phenomenon that is contingent (कादाचित्क)
cannot be uncaused—अकारणस्य हि कार्यस्य निमित्तं सर्वं
अवच्छेदं वा स्यात्, अनपेक्षत्वात् न कादाचित्कतम् । And with the
limitation of a specific effect, there must be only
one specific cause, for an unrestricted plurality of
causes would amount to the denial of uniformity in
causality (i. e., of the unconditional invariable
antecedence)—

नापि अनेकं कारणं, अकारणमवसङ्गादिव । वृत्तानन्तरमेव भाव इति हि
धूमस्य बहिर्कार्यत्वम् । स चेत् अवहुरपि अनन्तरं, न एककारणं स्यात्,
इति न बह्वुः कार्यम् । एवम् अन्यस्यापि न कार्ये । न हि अन्यानन्तरमेव
भवति, बहुरपि अनन्तरं भावात्, तद्वत् अद्वैतकी धूमः स्यात् । तदा च
कादाचित्कत्वव्याप्तिः ।

Nyāya rejoinder :—सत्यम् । यद्यपि विद्या बहिर् नोपपत्त्यो
धूमः, यद्यपि च विद्यान्तान्तरं नोपपत्त्यौ विद्याननुपपत्त्यौ, तद्यपि विद्या-च-

कार्यं एव धूमः । तत्र तत्र वह्निः कुतश्चित् स्वर्गिणीः उपनिषतिनः, रासभ इव,
न धूमस्य जनकः । तेन तदभावेऽपि तज्जातीय एव कारणमिदञ्चा
कदाचित् कादाचित्की धूमः स्यात् । इति अनिर्दिष्टेन प्रज्ञायाः ।
न च दृष्टव्यत्वे मादृशं कस्यचित् युक्तम् इति शक्यं भवार्थक्रुम् । अनुप-
लब्धिलक्षणमात्रस्य अशक्यनिराकरणत्वात् (vide Nyāya Vindu) । न च
अनुपलब्ध्यान्तराणि अपि तन्निमित्ते सम्भवन्ति । तस्मात् अन्तरात्मेव इति
अवधारणाभावात् नैव कार्यकारणभावधारणं युक्तम् । न च यदय-
मुद्दिष्टानन्तरं उपलब्धं तत्तदन्तरदिशात् तज्जात् भवत् भिन्नजातीयं भवति ।
अतः हि रामभक्त्यात् वद्वैः सादृश्यं धूमः सादृश्य एव तद्वर्तमानत्वं वद्वै-
रिति । तथादेवंविधा गङ्गापिङ्गाक्षी स्वनिवारकं तदुद्भूतिनिवृत्त्यास्तद्वर्ती
न शक्या निवारयितुम् ।

The Nyāya proceeds to point out that what is contingent need not necessarily be produced by a cause. It is enough if there is natural connection with something else, a relation of antecedence and succession (or concomitance), without any element of productive efficiency or causation.

अपि चास्तु तदुद्भूतिनिवृत्तिः तथापि कस्यान् कारणमन्तरैव न कार्यं
भवति । तथा च सति अनपेक्षतया कादाचित्कत्वविवृतिः इति चेत् ।
अस्तु तर्हि सम्बन्धः स्वाभाविकतया अन्तरापेक्षः अव्यभिचारी समकालाहम् ।
स च यो वा स वा भवतु । अतः कार्यकारणभावधारणायुक्तिः । यथा
चेत्तत् तथा चेत् दर्शयिष्यामः । Vāchaepati, Tātparyya-Tika,
Chāp. I, A'hnika 1, Sutra 5, व्यातिरक्षोपासनिवारः ।

The Nyāya analysis of the causal relation continued :—Co-effects.—In the enumeration of dif-

ferent varieties of irrelevant antecedents (*व्यवहित*), we have already noticed that co-effects of the same Cause are apt to be confounded as cause and effect. In some cases, the co effects may be simultaneous, *e.g.*, the case of the ascending and the descending scale in a balance, which are co-effects of gravity (*vide* Partha-sarathi Mîtra on Kumârita, SlokaVârttika—*गुलानमनोमसदयोस्तु न द्विधः कार्यकारणतन्, समवेरिककारणतान्*,—sloka 157, *Sūnya-Vāda*). In other cases, the co-effects may be successive effects of the same cause, and here the risk is great of mistaking the antecedent co effect to be the cause of the succeeding co-effect ; *e.g.*, the case of ants moving in a line to carry their eggs upward, which is observed before the summer rains ;—where the movement of ants and the rains are not cause and effect, but successive effects of the same cause, *viz.*, the heat (*उष्ण*), which disturbs the elements, *viz.*, the earth and the atmosphere (*महाभूतबीज*) ; the ants being affected by this heat earlier than the atmospheric movements which bring the clouds and the rain.

(Uddyotakara, and Vāchaspati—*न च विधीलिकासहचरं सर्वस्य कारणमनुपलभ्यमानमस्तीति । असत्यमि तस्मिन् सर्वबीजवर्गे । सर्वभूतकारणस्य तु महाभूतबीजस्य विधीलिकासहचरं पूर्वकार्यम् । कथं तावत् सत्तु विधीलिका जीमिनी, वा खानि च खानि भूमिनामि सपरिहान् नयन्ति—Tātparyya—Tikā II, 2, Sutra 37).*

Synchronousness of Cause and Effect.—This is resolved into a case of simultaneous co-effects of the same ultimate cause, *e.g.*, the ascent of one scale and the descent of the other in the balance, which are not related as cause and effect, but are simultaneous effects of gravity. In other cases, the synchronousness is only apparent, the interval between the antecedent and the consequent being too small (सूक्ष्मकाल) to be apprehended (योग्यव्यभिचारात्) *e.g.*, in the case of the needle piercing a hundred soft lotus petals laid one upon another, where the steps are really successive; or the illumination of the whole room by the light of a lamp, where the succession is unperceived owing to the inconceivable velocity of light (cf. Kumārila, *Sloka-Varttika*,—हेतुहेतुमतां विदं योग्यव्यभिचारेणम्,—यत् एतावन्माद्युक्तं सूक्ष्मकालोक्तिं तत्र नः। दुर्लभं तु यथा विदुः पद्मपत्रमते तथा। *Sānyavāda*, *Sloka* 156-157.—I quote *Mimāṃsā* authorities, but the view is common to the *Mimāṃsā* and the *Nyāya-Vaiśeṣika*).

The time-relation in a chain of causes and effects :—A careful study of the time-relation in a chain of causes and effects is a peculiarity of the *Vaiśeṣika* system (and the later *Nyāya*). A moment (ultimate unit of time, *Kṣana*, क्षण) is defined to be the time-interval between the completion of the sum of conditions and the appearance of the effect. The *Vaiśeṣika* conceives the unit to be determined by reference to the division

of one atom from another (विभाजानुत्पत्त्यवधिमात्रं प्रागभावेनानुत्पत्त्यवधिमात्रः कालः इत्यः—*Sapta Padārthī*, *Sivāditya* ;—i.e., the ultimate unit of time is the time during which motion exists in an atom prior to its division from another atom, in a case of division due to motion). The *Sāṅkhya*, we have already seen, determines this ultimate unit by reference to the motion of a *Tanmātra*.

The number of such units will determine the time-interval between a given set of physical conditions and a particular effect, for between a so-called sum of causes and a so-called sum of effects, there intervenes a series of atomic (or molecular) motions, with conjunctions and disjunctions which form the causal chain. However crude in the practical application, the fundamental idea is, in connection with the principle of work and energy (for which both the *Sāṅkhya* and the *Nyāya-Vaiśeṣika* furnish a rudimentary basis), immensely suggestive of a possible Time Calculus.

Plurality of Causes :—This will be discussed, when we consider the relation of *Vyāpti* to the principle of Causality.

The Nyāya Ground of Inference—*Vyāpti* (न्यायप्रमाण—*Vāchaspati*) :—Inference, then in the *Nyāya*, depends on the ascertainment, not of the casual relation, nor of the relation of genus to species, but of a natural relation, between two phenomena, of invariable and unconditional concomitance

(उद्योतकः आभासकः समस्तः अग्निः—Uddiyotakara and Vāchaspati). Of the two phenomena so connected, one is called the Vyāpya or Gamaka (the sign, mark or indicator), and the other Vyāpaka or Ganya (the thing signified, marked, or indicated). In the relation of fire and smoke, for example, smoke is the Vyāpya or Gamaka (sign or mark); and fire, the Vyapaka or Ganya the thing signified or marked). Now the relation of Vyāpti between *A* and *B* may be either unequal or equipollent (विषमव्याप्ति or समव्याप्ति). When *A* is the sign of *B*, but *B* is not the sign of *A*, the Vyāpti is one-sided or unequal, and here a Vyāpti is said to exist between *A* and *B*, but not between *B* and *A*. For example, smoke is a sign of fire, but fire is not universally a sign of smoke. When, therefore, the relation of Vyāpti is an unequal one, as between smoke and fire, it is expressed in the proposition :—Wherever the Vyāpya (sign or mark, *e.g.*, smoke) exists, the Vyāpaka (the thing signified or marked, *e.g.*, fire) also exists. From this it follows by necessary implication (a sort of व्यतिरेक) that whenever the Vyāpaka (*e.g.*, fire) is absent, the Vyāpya (*e.g.*, smoke) is also absent (व्यापकान्नापि व्याप्यमना). Again the Vyāpti may be a mutual or equipollent one, *i.e.* *A* and *B* may be signs of each other, *e.g.* green-wood fire and smoke. Here each in turn is Vyāpya and Vyāpaka, and this is expressed in

the two propositions:—(1) Wherever there is smoke, there is green-wood fire, and (2) wherever there is green-wood fire, there is smoke. By necessary implication it follows—(1) where there is no green-wood fire, there is no smoke: (2) where there is no smoke, there is no green-wood fire. We have seen that a Vyāpti exists between smoke and fire, for wherever there is smoke, there is fire. But we cannot say that a Vyāpti exists between fire and smoke, for we cannot say that wherever there is a fire, there is smoke. The combustion of an iron-ball (लोहगोला), for example, is a case of fire without smoke. But it would be correct to say that a Vyāpti exists between green wood fire and smoke, as well as between smoke and green-wood fire. The question, therefore, is—What is the relation between fire and smoke? The relation between fire and smoke is a conditional relation; i.e., on condition that the fire is green-wood fire, it would be a sign of smoke. In other words, a Vyāpti implies unconditional invariable concomitance, and the relation between fire and smoke is not therefore a Vyāpti (natural unconditional concomitance), for fire requires a 'condition,' Upādhi. *viz.*, green-wood, to be followed by smoke. Smoke, on the other hand, requires no 'condition' to indicate fire. For the purposes of Inference, therefore, relations between phenomena may

be considered as of two kinds:—(1) Contingent conditional relations, holding good on the fulfilment of a certain condition or Upādhi, and (2) Vyāpti, or unconditional invariable relation, between a mark and that which it makes, a relation without any Upādhi or determining condition (उपनिविष्टः सम्बन्धः). It is this latter kind of relation that serves as the ground of Inference. If we can ascertain that a Vyāpti exists between *A* and *B*, then *A* is a sign of *B*, and an inference of the presence of *B* from the presence of *A*, and of the absence of *A* from the absence of *B*, would be warranted. The question, therefore, is—how to ascertain the relation of Vyāpti between two phenomena.

Ascertainment of Vyāpti according to the early Nyāya (अनिवर्तनीयत्व).—Briefly speaking, the observation of agreement in presence (सम्बन्ध) as well as agreement in absence (अतिरिक्त), between two phenomena, with the non-observation of the contrary (अनिवर्तनीयत्व), is the foundation of our knowledge of Vyāpti (दर्शनादर्थज्ञे—Vāchaspati). This suggests a natural relation (सामाविकसम्बन्ध—Vāchaspati) of invariable concomitance (निवर्तनीयत्व—Vāchaspati) between the phenomena, which is fortified by our non-observation (अदर्शन) of the contrary (अनिवर्तन). But this does not establish the unconditionality of the concomitance (उपनिविष्टसम्बन्ध), which is essential to a Vyāpti. We have therefore to examine the cases carefully

to see if there is any determining condition (Upādhi—i. e. some hidden or undetected but really operative or indispensable accompaniment) which conditions the relation between the supposed sign or mark (Gamaka) and the supposed signate (thing signified, Gymya). Now let us consider what constitutes an Upādhi. It is a circumstance which always accompanies, and is always accompanied by, the supposed signate (the thing signified, Gamya), but does not invariably accompany the supposed sign or mark (Gamaka). If, therefore, in the set of positive instances where both the sign and the signate are present, nothing else is constantly present, there can be no Upādhi. Or, again, if in the set of negative instances where both the sign and the signate are absent, no other material circumstance is constantly absent, there is no Upādhi. This follows from the very definition of an Upādhi. It is impracticable to fulfil these requirements rigorously. Still, every one of the accompanying circumstances (of course the likely ones) may be taken successively, and it may be shown that the concomitance continues even when the suspected Upādhi (अतिशयोक्ति) is absent, and therefore it cannot be the Upādhi. And this is to be fortified by the observance of uniform and uninterrupted agreement in absence (Vyatireka) between the two concomitant phenomena. In this way, when we have disproved all

suspected Upādhis, we conclude by establishing the Vyāpti. It is true that we may still go on doubting. But doubt has a certain limit for the 'experimenter' and the thinking person (परीक्षक, विचारक). When doubt overthrows the foundation of all rational practice (व्यावहारिकजीवन), or leads to a stoppage or arrest of all practical activity (सोपव्यवहार), it stands *ipso facto* condemned, and must be abandoned (त्यागार्हपरामर्श). Śrīharsha and Udayana—व्यवहार is mentioned by Vāchaspati). Thus it is that Vyāpti is ascertained. In this way, we observe innumerable instances of Vyāpti. Now by means of repeated observations of this kind (सूक्ष्मदर्शन), we have established the principle of the Uniformity of Nature (समवयवित्व), and also of Causality; and these two principles thus ascertained may be made use of in their turn as the basis of an argumentation or deduction (Tarka, U'ha, तर्क) to confirm a particular Vyāpti in a particular case. Tarka or U'ha, then, is the verification and vindication of particular inductions by the application of the general principles of Uniformity of Nature and of Causality, principles which are themselves based on repeated observation (सूक्ष्मदर्शन) and the ascertainment of innumerable particular inductions of uniformity or causality (सूक्ष्मदर्शनजनितसंस्कारवृद्धिर्न रक्ष्यतेन व्यावहारिकसम्बन्धादि—Vāchaspati). Thus Tarka also helps in dispelling doubt (सन्देह). Śrīharsha,

however, questions the validity of this verification, —cf. the well-known couplet ending सर्गः परावधिः कृतः।

It will be seen that the process of disproving all suspected Upādhis (उपाधिप्रहाराय), in the early Nyāya, answers exactly as a process to Mill's Method of Agreement. In fact, the disproof of a suspected Upādhi by pointing to instances of Agreement in absence (अवय) even in the absence of the Upādhi, fortified as this is by the instances of agreement in absence (अतिरिक्त), virtually amounts to Mill's Joint Method of Agreement. But the fundamental difference is this :—Mill's Method of Agreement is formulated in view of the phenomena of causation (including co-effects, etc.) and, as usually enunciated, confessedly breaks down in dealing with cases of Uniformities of Co-existence unconnected with Causation; the Nyāya Method based on the disproof of suspected Upādhis is a more daring and original attempt, and is far more comprehensive in scope, being applicable to all Uniformities of Co-existence and of Causation alike. And this the Nyāya successfully accomplished, by introducing the mark of unconditionality (उपाधिविमुक्तता) into the relation of Vyāpti (Concomitance), even as the same mark of unconditionality (अवयवविशिष्टता) had been previously introduced into the definition of Causality (कार्यकारणभाव). The difference between the early Nyāya and the Buddhist systems

may be briefly put thus :—The former relied on empirical induction based on uniform and uninterrupted agreement in Nature, and accordingly regarded the Method of Agreement as the fundamental Method of Scientific Induction, founding Inference on Vyāpti to which they subordinated Causality in the doctrine of Method ; the latter assumed two *a priori* principles, viz., causality and identity of essence, deduced the canon of the Method of Difference by an indirect proof from the principle of causality, and made this Method the foundation of all scientific Induction of Causality, just as they based all natural classification of Genera and Species on their *a priori* principle of Identity of Essence.

[Text from the early Nyāya :—

Method of Agreement and the Joint Method without the device of the Upādhi :—

Cf. Jayanta on सादृश्यम्—तस्मिन् सत्येव भवती न विना भवन् नतः । चक्षुर्देवाविज्ञाभावे नियमः सहचरितः । 'तस्मिन् सत्येव' 'only this remaining throughout,' while others change—implying the Method of Agreement. The set of positive instances, in which this antecedent alone is constant, must be supplemented by a set of negative instances (agreement in absence) :—अतिरिक्तनिवृत्त्यसत्त्वमिदं प्रतिपन्नसहचारादुपपत्तेः । निवृत्त्यर्थं चक्षते इत् तस्मिन् सति भवन् ततो विना न भवन् इति भूयोदर्शयन् । तत्र तस्मिन् सति भवन् इत्यवस्थाना-

परिच्छेदान् अर्हयद्दीप्ती निवृतः स्थात् । ततो विना न प्रवर्तनं वक्ष्ये
अर्हस्य अपरिच्छेदान् इति Jayanta, A'hnika II, व्यतिरेकव्याप्ति-
निवृत्त्यावश्यकतम् ।

Doctrine of the Upādhi :—Unconditional con-
comitance distinguished from conditional :—

धी मा ल वा अस्तु सत्त्वः यस्तु अनी स्वाभाविकी निवृतः स एव सत्त्वः,
सत्त्वश्च इतरः सत्त्वश्चीति युज्यते । तदा हि धूमादीनां बहुधादिसत्त्वः
स्वाभाविकः । तत् बहुधादीनां धूमादिभिः । सत्त्वस्यने ते हि विनापि
धूमादिभिः । यदातु आर्हस्यनादिसत्त्वस्य अनुसर्गनि तदा धूमादिभिः सत्त्व
संबध्यते । तस्मात् बहुधादीनाम् आर्हस्यनाद्युपाधिजनः सत्त्वश्च न स्वाभा-
विकः । ततो न निवृतः । स्वाभाविकस्तु धूमादीनां बहुधादिसत्त्वस्य उपादेः
अनुपलब्धत्वात् क्वचित् व्यतिचारस्य अर्हयनात् अनुपलब्धत्वात्स्यापि
ककनानुपपत्तेः । अतो निवृतः सत्त्वः अनुसर्गावस्थम् ।

Concomitance sufficient without causal nex-
us :—

The Buddhist objects—In Nature, everything is
connected with everything else. Hence if there
were no *nexus* of causality between antecedent
and consequent, everything might follow from
everything else. The Nyāya replies—You admit
uniformities (of co-existence, etc.) other than
causal ;—so you confess that a natural fixed order
can exist without causal *nexus*.....

An Upādhi, how established and how dis-
proved :—

The Nyāya then proceeds to show how an Upādhi

is established, or how disproved by observation.—

ननु वक्तुः अपादैश्वर्यं विना धूमं अपोलीलकादी दर्शनात् आदैश्वर्यो-
पाधिः अत्र धूमिन सत्त्वः न तु स्वाभाविक इति निरूप्यते । धूमविशेषात्
तु विना वदितुं अनुपलब्धात्, उपविशेदस्य न अदृग्मानस्य कल्पनायां
प्रत्याभावात्, विशेषकृत्यदेशस्य च संशयस्य अनुपलब्धपूर्वम् अनुप-
लब्धात्, उक्त्यादेः च अतिप्रसङ्गात् तेषामतु मूल्यार्थेदात्, स्वाभाविकः
सत्त्वः अवधार्यते ।

General Method of Induction by exhaustion
of the Upādhi, more comprehensive than Mill's
Joint Method :—

For the definition of an Upādhi, vide Śrīharsha and
Udayana : अथाप्रसाधनी यः साध्यसमव्याप्तिः उच्यते स उपधिरिति ।
Hence to avoid an Upādhi (which is साध्यसमव्याप्तिः),
the constant presence of anything relevant other
than the sign and the signate in the positive in-
stances (of agreement in presence, सत्त्वः), and the
constant absence of any such thing in the negative
instances (of agreement in absence, अतिरिक्तः) must
be safe-guarded against. This amounts to Mill's
Joint Method.

Suspicion of non-perceptible Upādhi—Limits of
legitimate Doubt :—

न च अदृग्मानोऽपि दर्शनालक्षणाया साधकसाधकसमव्याप्तावेन
सहिष्णुमान उपधिः स्वाभाविकत्वं प्रतिपद्यति इति साध्यतम् । अवश्यं
अत्रापि 'अविशेष' नियमकामवादिनि दृष्टावकाशा खलु इयम्
असाध्यसमव्याप्तिकर्तव्यं प्रत्यापिमाणी लक्षणस्य न कश्चित् साक्षीति तेषां

कथितं प्रथितं । सर्वत्रैव कथायितुं कथायितुं अनर्थकं सङ्गाहदत्तात् ।
 अनर्थककथायाश्च प्रसादतां निवृत्त्यङ्गत्वात् । अतः । सिद्ध्यारब्धप्राप्तेर्वैयर्थ्यं
 अपि सरथादिदर्शनात् । तथात् प्रामाणिकलीकयानात् अनुपास्यतः
 यथादर्शनं शङ्कनीयम् ।.....तथाऽनुपाधिं प्रयत्नेन अन्विष्यतीदनुपलभमाना
 गच्छीति अदम्य खड्गाविकले प्रत्यक्षं निश्चिनुतः ।—

Turka, U'ha,—Deductive verification of particular inductions by applying the two fundamental inductions of Uniformity of Nature, and Causality :—Doubt finally dispelled :—

Now innumerable particular uniformities of this kind (Vyāptis) are observed, and as a result of this repeated observation, a belief in the Uniformity of Nature (स्वाभावित्वम्), as well as in the principle of Causality (कार्यकारणभाव) is generated in the mind, a belief which has evidential value and validity. It is not intuition (न ज्ञानम्) but a mental pre-disposition based on uniform and uninterrupted experiences (भूयोदर्शनजनितसंस्कारसहितम् इन्द्रियैश्च स्वाभाविकवत्त्वमप्रापि,—अत्र भूयोदर्शनम् असाधारणम् इति इत्युक्तमर्थं ज्ञानम्). Then armed with these new resources, the belief in uniformity and in causality as general principles, we proceed to fortify our particular inductions (Vyāptis), whether of uniformity of nature or of causality, by indirect deduction from these general principles :—We argue if, under these observed circumstances, *A* were not the mark of *B*, the principle of uniformity of nature would be violated,—Nature would not be uni-

form,—or, if under these observed circumstances *A* were not the cause of *B*, the principle of causality would be violated, the phenomenon *B* would be without a cause ;—and such indirect proof (तर्कज्ञाप) gives us the overwhelming probability which we call practical certitude, and on which every reasonable man (every thinking and judging person) proceeds to act in due natural course.—समावृत्तस्यातिवृत्त्याऽतएव; समावृत्ते, यदि साध्यमकारणे न भवेत्, तदा समावृत्तस्य विरतिर्न तर्कसहायः अनिरुद्धसाध्यत्वनिर्देशकसिद्धिः स्यादित्यतः समावृत्तं व्यवस्थापयन्ति । Vāchaspatī I, 1, Sūtra 5 : cf. also, I, 1, Sūtra 40—कहः कारणस्वीयत्वा संभवेन सावरे । कारणान्तरैः कार्यस्य असत्त्वान् ।]

Instances of Vyāpti (uniformity) not comprehended under Causality, or the relation of Genus and Species :—The Nyāya points out that the relations of cause and effect and of genus and species do not exhaust the grounds of Inference. There are cases of Inference based on Vyāpti (i. e., on invariable and unconditional concomitance) which come neither under Causality (तद्वृत्ति) nor under Identity of Essence (सादात्म्य). Vāchaspatī notes that to-day's sunrise and yesterday's sunrise, the rise of the moon and the tide in the ocean, the relative positions of the stellar constellations, are instances of Vyāpti (invariable concomitance) between phenomena which are neither related as cause and effect, nor as genus and species. Jayanta adds the conjunction of sun-set with the appearance of the stars,

of ants moving in procession (with their eggs) with the approach of the rains,—of the rising of the constellation Agastya (Canopus) above the horizon with the drying up of rivers; of the spring tide with the full moon; and dismisses as sophistical and far-fetched the Buddhist attempt to explain all these cases by means of causality. We have seen that the Nyāya and the Mīmāṃsā reduce most of these conjunctions to cases of co-effects of the same cause, co-effects which may be either simultaneous or successive.

अपि च अकस्मत्कं सविशुद्धयस्तु जायतेन सविशुद्धयेन, चन्द्रोदयस्तु च समानकालेन समुदयश्च.....न कार्यकारणभावः तादात्म्यं वा । अथच दृष्टौ समसकभावः ।—Vāchaṣpati, Tātparyya-tīkā, I, 1, Sūtra 4;—*Of. also Jayanta, Nyāya Manjarī*—चनेवाऽपि हेतुर्न भूत्वा भवति दर्शनात् । सूर्याकसमसाक्षौक्यं कल्पते तारकीदयः । पूर्वचन्द्रोदयाद्द्विरमुषैरवगच्छते । अद्वितेनानुमीयते सारितः कुम्भयोगिनः । सूर्यानुपनिषत्कालं दिशान्तरवर्तकः । विपरीतिकाश्वरुचारचैदातु-मितवदयः । भवति यथिकाः पर्यकुटीरकरषोद्यताः ।

Vyāpti between Cause and Effect :—Relation of causality to Vyāpti :—

On the Buddhist (and early Nyāya) view that one specific assemblage of 'effect' phenomena has one specific assemblage of causal conditions, there would be two aggregates, the sum of causal conditions (कारणसामग्री), and the sum of effects (कार्य-सामग्री). For example, fire requires green-wood to complete the sum of causal conditions to give rise to smoke with some particular marks (धूमनिर्देश,—

बहुलवायुलादिभवेतिदिष्ट, Jayanta II ; compare Gangesa
 ज्ञानानुसंगदार्ष्टान्त्यर्थं कदाचान्निवाच्यरूपकत्वात् — Chintā-
 māni, Anumana, Viruddha Siddhānta). Here, between
 an effect and a single condition (termed a cause)
 there is a relation of Vyāpti. The effect is Vyāpya or
 Gamaka (the sign or mark) ; the cause (or condition)
 is Vyāpaka or Gamya (the thing signified). In
 other words the presence of the effect indicates
 the presence of the causal condition, and the
 absence of the causal condition will by implication
 indicate the absence of the effect. Smoke of this
 particular kind is supposed to be an effect of
 which there is one and only one assemblage of
 causal conditions (fire and green-wood) ; hence
 where there is smoke, there is fire ; and when there
 is no fire, there is no smoke.

Now introduce the complication of the plurality
 of causes :—Fire, for example, is the effect of
 several assemblages, *e. g.* (1) blowing on heated
 grass, (2) focussing rays through a lens on a com-
 bustible like paper or straw, (3) friction with the
 fire drill, etc. Here each assemblage is regarded
 as a sum of causes. But in this case there is no
 Vyāpti between the effect 'fire' and any particular
 assemblage of causal conditions, say, of the lens
 or the fire drill. For the presence of fire does
 not indicate the presence of the lens or the fire
 drill assemblage, nor does the absence of either of
 the latter in particular, indicate the absence of fire.

Indeed in such a case, the effect 'fire' is not a mark or sign (Gamaka or Vyápya) of any one in particular of the different possible causal assemblages, though each of these particular assemblages of causal conditions is a mark or sign (Gamaka or Vyápya) of fire.

The plurality of causes requires a further consideration in the light of the definition of the causal relation. A cause is defined to be the unconditional invariable antecedent. From the unconditionality, it follows that the entire sum of conditions, and not one single condition, is, properly speaking, the cause. In view of the plurality of causes, an invariable antecedent must be taken to mean that any particular cause (i. e., assemblage of causal conditions) is invariably followed by the effect,—not that the effect is invariably preceded by any particular cause.

Popularly, a single condition, say the lens or the fire-drill, is said to be a cause of fire ; but, in view of the plurality of causes, this is apt to be misleading, as there is no Vyápti in this case : the lens or the fire-drill is no more a mark of fire than fire is a mark of the lens or the fire-drill.

The plurality of causes strains the definition of a cause, and undermines the relation of Vyápti between an effect and a cause. Any particular cause (causal aggregate) still indicates the effect, but not vice versa. The earlier Nyāya (down to

Vācaspati and Jayanta) obviated the plurality, as we have seen, by introducing distinctive marks in the effect such as would indicate a single specific cause (कारणवैलक्षण्य or कार्यभेद indicating कारणवैलक्षण्य or कारणभेद). Some indeed went further and held that when the antecedent causal assemblages differ in kind, the effect phenomena, though apparently the same, do really differ specifically (or in kind)—कारणवैलक्ष्यात् कार्यवैलक्षण्यम्. But the Nyāya discards this hypothesis; the fire is the same, though the possible causes (or causal aggregates) differ, *e. g.*, the lens, the drill, etc. But the effect phenomenon to which we attend is not the only effect;—in the case of plurality of causes, we must carefully examine the accompaniments of the effect, *i. e.*, the sum of effects, and the examination will shew some distinctive or specific circumstance or accompaniment which will enable us to definitely determine the particular assemblage of causal conditions that must have preceded in the case under examination. This is the device of the earlier Nyāya as well as of the Buddhists, as we have seen; but the later Nyāya doubts the practicability as well as the theoretical validity of such a step on an unrestricted assumption of the plurality of causes, and feels troubled by the circumstance that no effect for which more than one cause (or causal aggregate) can be assigned, can be regarded as a mark or sign (Gamaka or Vyāpya) of any one of

the causes in particular. Accordingly, some adherents of the later Nyāya advanced the proposition that when more than one causal aggregate can be supposed for any effect, the latter is a mark or sign (*Gamaka* or *Vyāpya*), not of any one of the causal aggregates in particular, but of one or other of them ; and the absence, not of one such cause, but of each and every one of them, alone indicates the absence of the effect. A cause therefore should be defined to mean *one or other* of the possible alternative aggregates which, being given, the effect follows invariably and unconditionally. If we ask what is the defining mark (or quiddity) of the cause (कारकत्वमिदं), we are told that it is *one-or-otherness* (अथवत्त्व), and nothing else ; others cut the Gordian knot by assuming that the different possible causes of the same effect possess a common power or efficiency (वतिरिक्तशक्ति), or a common 'form' (जातिबोधा), which accounts for the production of a common effect. The latter is therefore a sign or mark of this power (शक्ति), or this form (जातिबोधा), which is manifested by each of the causal aggregates. This hypothesis (कथना), they hold, is simpler and more plausible than the hypothesis of specific differences latent in the apparently identical effect of a plurality of causes (कारकवैजात्यान् कार्यवैजात्यन्).

(Cf. *Dinakarī* on the *Siddhanta Muktavalī*—*विहितं*
वति प्रति ह्यकुत्कार-संयोगादीनां ह्यकुत्कारसंयोगादिवदेव

कारयतया व्यभिचारीय असम्भवात् अतिरिक्तशक्तिविनाः । न च
 दृश्यकृतकारणीः अविनिर्मेयेताः अतिरिक्तिकरणयोश्च सम्भवस्य
 कल्पनाशब्देनैव विग्रहितवैकान्त्यसर्वं कल्पकिति न व्यभिचार इति वाच्यम् ।
 तज्जन्तानाशब्देनैकान्त्यसर्वकल्पनामपेक्ष्य तत्तत्सम्भवात् एकशक्तिमत्त्वं
 कारयतकल्पनाया एव लघुत्वेन न्याय्यतात् इत्याहुः । ननु ।... अन्तमत्तेन
 कारयतासम्भवात्..... परे तु त्वयादिदृश्यत्वकात्वीरवायुर्नदीगादीनां एक-
 शक्तिमत्तेन हेतुतासादाय विविक्तताविरहात् न शक्तिविनाः इत्याहुः ।
 Sloka 2, cf. also, त्वयादिदृश्यत्वान्तमत्तं कारयस्य विविक्तमम् ।

Cf. Udayana, Kusumāñjali, Stavaka 1— कर्तृर्हि
 त्वयादिमविनी मन्त्राद्यव्यभिरेकजातीयः । एकशक्तिमत्तात्
 इति चेत् न । यदि हि विजातीयेषु यदि एकजातीयकार्यकारण-शक्तिः
 सन्विद्यता, न काश्चात् कारयविशेषः कृतिन् अनुनीयित । कारयत्वात्तया च
 न तज्जातीयस्यैव कार्यस्य व्याप्तिरवसीयेत..... एतेन तुक्कादीयमिति
 निरकम् । अवज्ञेरेवि तद्दीक्षात् कृतीतवत्त्वादेः ।

The Scientific Methods already noticed, the
 Joint Method of Difference (the Panchakāraṇi),
 and the Joint Method of Agreement (Vyāptigrāha
 with Upādhisankā-nirāsa and Tarka), are not the
 only methods of ascertaining causality or concomi-
 tance, or establishing a theory (विज्ञान); nor are these
 Methods always practicable. Very often, we reach
 the explanation of a fact (उपपत्ति) by means of a
 Hypothesis (कल्पना) properly tested and verified
 (निर्वीर्य). A legitimate Hypothesis must satisfy the
 following condition :—(1) the hypothesis must
 explain the facts (हरसिद्धि, or उपपत्ति; (2) the

hypothesis must not be in conflict with any observed facts or established generalisations (इदमिदं हि षट् कथाने, न इदमिदमज्ञात—Jayanta, Nyāya-Manjari, A'hnika 1); (3) no unobserved agent must be assumed, where it is possible to explain the facts satisfactorily by observed agencies (यदि षट्कर्मज्ञेन इदं न विज्ञाति कामनदृष्ट कथानाम्, अन्यथापि नदुपपत्तौ किं नदुपपत्त्यनेन, *ibid*); (4) when two rival hypotheses are in the field, a crucial fact or test (विनिगमक, *ratio sufficiens*) is necessary ; the absence of such a test (विनिगमनाविरह) is fatal to the establishment of either, (5) of two rival hypotheses, the simpler, i.e., that which assumes less, is to be preferred (*ceteris paribus*) (कथानांघन versus कथनामौघः); (6) of two rival hypotheses, that which is immediate or relevant to the subject-matter is to be preferred to that which is alien or remote (प्रसंगोपस्थितत्व); (7) a hypothesis that satisfies the above conditions must be capable of verification (निर्णय) before it can be established as a theory, (विज्ञान). The process of verification of a hypothesis consists in showing that it can be deduced as a corollary from (or is involved by implication in some more general proposition which is already well-established (cf. Vatsyayana's exposition and illustration of Verification, निर्णय—including both the Deductive Method and Colligation).

This doctrine of Scientific Method, in Hindu Logic, is only a subsidiary discipline, being com-

prehended under the wider conception of Methodology, which aims at the ascertainment of Truth whether scientific (Vijnana) or philosophical (Jnana) (कीचे वीज्जानसु खान्तिनामं विज्ञानाच्छब्दे, Amara-Kosha);—the latter being the ulterior aim. In the investigation of any subject, Hindu Methodology adopts the following procedure. (1) the proposition (or enumeration) of the subject-matter (Uddesa), (2) the ascertainment of the essential characters or marks, by Perception, Inference, the Inductive Methods, etc.,—resulting in definitions (by लक्षण) or descriptions (by उपलक्षण); and (3) Examination and Verification (परीक्षा and निर्णय). Ordinarily the first step, Uddesa, is held to include not mere Enumeration of topics, but Classification or Division proper (विभागः सङ्ग्रेहप्रधानप्राधान्यं लक्षणं पञ्चाङ्गी । कात्यायनसंज्ञया कीर्तनसुरेणः प्रकाशनेदकं प्रया । कीर्तनं विभाग इति—Jayanta, Manjari); but a few recognise the latter as a separate procedure coming after Definition or Description. Any truth established by this three-fold (or four-) fold procedure is called a Siddhanta (an established theory). Now the various Pramānas Proofs, i.e., sources of valid knowledge) in Hindu Logic, viz., Perception, Inference, Testimony, Mathematical Reasoning (लक्षण including Probability in one view) are only operations subsidiary to the ascertainment of Truth (तत्त्वनिर्णय). And the Scientific Methods are merely uncillary to these Pramānas themselves.

I have explained the principles of the Hindu doctrine of Scientific Method, avoiding the technicalities of Logic as far as possible; and I cannot here enter upon the logical terminology or the logical apparatus and machinery, which would require a separate volume to themselves. For these, I would refer the reader to my paper on Hindu Logic,—as also for an account of the later Nyāya (न्याय), which, in spite of its arid dialectics, possesses a three-fold significance in the history of thought: (1) logical, in its conceptions of *Avachchhedaka* and *Pratīyogi*, being an attempt to introduce quantification on a connotative basis, in other words, to introduce quantitative notions of Universal and Particular, in both an affirmative and a negative aspect, into the Hindu theory of Inference and Proposition regarded connotatively as the establishment of relation among attributes or marks; (2) scientific, in its investigation of the varieties of *Vyāpti* and *Upādhi*, (and of *समसङ्ग*) being an elaboration of Scientific Method, in the attempt to eliminate the irrelevant; and (3) ontological and epistemological, in its classification and precise determinations of the various relations of Knowledge and Being, with even greater rigidity and minuteness than in Hegel's Logic of Being and Essence. I will conclude with a few observations on Applied Logic, i.e., the logic of the special sciences, which is such a

characteristic feature of Hindu scientific investigation. What is characteristic of the Hindu scientific mind is that without being content with the general concepts of Science and a general Methodology, it elaborated the fundamental categories and concepts of such of the special sciences as it cultivated with assiduity, and systematically adapted the general principles of Scientific Method to the requirements of the subject-matter in each case. The most signal example of applied logic (or Scientific Method) worked out with systematic carefulness is the Logic of Therapeutics in Charaka, a Logic which adapts the general concepts of cause, effect, energy, operation, etc., and the general methodology of science to the special problems presented in the study of disease, their causes, symptoms and remedies (*vide* Charaka, *Vimānasthāna*, Chap. IV,—also *Sūtra Sthāna*, — *vide* my Paper on Hindu Logic). Here I will give an illustration of Applied Methodology from the Science of Analytical and Descriptive Grammar. Patanjali, in the *Mahābhāṣya*, (Circa 150 B. C.) is very careful as regards Methodology. I take no note now of the philosophical presuppositions of his philology (*vide* my Paper on the Hindu Science of Language), but will confine myself to his presentation of the Applied Logic of Descriptive and Analytical Grammar. The sentence is the unit of speech, as every Hindu philologist contends, but the first business of Analytica

Grammar is to analyse the sentence into its significant parts and their coherent relations to one another. Assuming that articulate sounds are significant, the question is.—how is the sentence, which is the unit of articulate speech, broken up into significant words and their mutual relations? Pātanjali answers that this is done by an instinctive use (cf. Vāchaspati's *सूत्रं दर्शनमिति संस्कारम् इन्द्रियम्*) of the Joint Method of Difference (combined Addition and Subtraction), fortified by the Joint Method of Agreement (*सम्यग्-सदृशको*). Pātanjali starts with a simple case. Take the two sentence-units :—Pathati (he reads) and Pachati (he cooks'. Suppose you start with the assumption that these sounds are significant, and *that separate elements have separate meanings*. Then you hear Pathati, and, at the same time, a man reading is pointed at. Then the assemblage of sounds Pathati (i. e., Path+ati) stands for the assemblage—'one reads,' (i. e. the action reading + an individual agent). Similarly by finger-pointing or other indication, you find that the assemblage Pachati i. e., Pach+ati) stands for the assemblage 'one cook's (i. e. the action cooking + an individual agent, say, the same agent as before).

Now look at the grouping :—

Path + ati = reading + one agent.

Pach + ati = cooking + one agent.

From repeated observation of similar groupings, one is led to conclude that path is the invariable concomitant of the action 'reading', because the disappearance of the formar (the other element remaining) leads to the disappearance of the latter (a rough Method of Difference by subtraction—दीर्घ); that Pach is the invariable concomitant of the action 'cooking' because the introduction of Pach (with nothing else added) leads to the introduction of the action 'cooking,' (a rough Method of Difference by addition,—उपपत्ति); and that Ati, which is the only 'common antecedent' (समन्वय), is the invariable concomitant of 'one agent' which is the only common 'consequent' (समन्वय). In fact, the last should come first by the Method of Agreement, then the other two either by Residue, or by Joint Agreement in presence and absence (समन्वय). So far all is plain sailing, though only very simple and very rough applications of the Methods are given. But—and this is the point—throughout the argument, it is assumed that one sound is the concomitant of one idea, in other words, there is no plurality of causes to vitiate the application of the Method of Agreement in the above example. And now the objection is advanced that this basal assumption is untrue. The same sound is not the concomitant of the same idea. Different words (sounds) may have the same meaning, and the same word (sound) may have

different meanings. We cannot therefore by the Joint Method of Agreement (अन्वयव्यतिरेकी) determine the meanings of words, or the separate functions of roots (stems) and inflections,—at least not so simply as is pretended above. Patanjali states this difficulty in the way of applying the Scientific Methods to the problems presented by Analytical Grammar, a difficulty arising from the plurality of causes, but does not state the solution. The solution, however, depends on the Method of subtraction and addition (Patanjali's वृद्धे and छेदनादे). For it will be found by extensive observation that the number of meanings of which a word (sound) may be capable is limited. So also is the number of words (sounds) expressive of a given meaning. Hence, by the Method of Difference, etc., the causal relations of words and meanings may be determined. Patanjali thus established the doctrine of Prakriti and Pratyaya (roots and inflections), with their separate significance, which is of course a necessary postulate in the case of an inflectional language like Sanskrit. Isolating and Agglutinative languages offer less difficulty, whereas the difficulties are in some respects enhanced in the case of languages with a polysynthetic or incorporating (incapsulating) morphological structure.

कथं पुनर्दर्शयेत् अयं प्रकृत्यर्थः अयं प्रत्ययार्थ इति । अन्वयव्यतिरेकाभावात्
कीदृशी अन्वयी व्यतिरेकी वा । इह पञ्चतीक्ष्णो कश्चिन् मन्त्रः दृश्यते,

पठतीत्युक्ते कश्चित् शब्दो द्योयते (वच्),—कश्चित् उपजायते (उद्),—
कश्चित् चत्वरी (चति);—अर्थाद्वि कश्चित् द्योयते (विज्ञिति);—
कश्चित् उपजायते (पठिज्ञिया),—कश्चित् चत्वरी (कृत्स्नं चैकत्वं);
तेन ह्यन्वामहे यः शब्दो द्योयते, तस्य चत्वी चर्थः द्योयार्थो द्योयते । यः शब्द
उपजायते तस्य चत्वी चर्थः द्योयते उपजायते । यः शब्दोचत्वरी तस्य चत्वी
चर्थः द्योयार्थोचत्वरी ।

विषय उपन्यासः—यद्यपि हि शब्दा एकार्था भवन्ति । तदुपस्था इन्द्रः
शक्रः पुरन्दरः । एकस्य शब्दो बहुर्थः । तदुपस्था यथाः पादा भाषा इति ।
अथ किं न साधोर्वीर्यवता विद्या भवति । तामि मूर्खोऽप्येवता न
सिध्यतीति । अर्थेता हि अर्थवता चत्वयज्यतिरेवाभ्यासेन । तत्र कुत
एतदर्थं प्रत्ययर्थः चर्थं प्रत्ययार्थे इति । (*Mahābhāṣya*, I—3, 9.)

Patanjali not only applies the Scientific Methods to the foundations of Grammatical Analysis, but also by *their means* establishes and elaborates the fundamental categories and concepts of Grammatical (and Philological) Science, *e. g.*, the concepts of action (क्रिया), agent (कर्ता), instrumental cause (करण साधकतमम्), end (निमित्त), origin (हेतु) limit (अवधि) substance (द्रव्य), quality (गुण), and genus (जाति);—also of the fundamental relations (at the bottom of all thought and speech)—the relations of Time (कालिकसम्बन्ध), of space (दिग्दर्शनसम्बन्ध), of causality (कार्यकारणभाव), of inherence (समन्य), of co-inherence (सामावधिकरण), of substance and attribute (विभक्त्यावधिकरण), of the sign and the signate (संज्ञासंज्ञितभाव), of mutual dependence (परस्परतन्त्रय);—an entire grammatical (and philological) apparatus, which will serve as a *point d'appui* for generations of philologists and grammarians to come.

ADDENDA.

(BY PRINCIPAL BRAJENDRANATH SEAL)

Empirical Recipes from Varahamihira (circa 550 A.D.) relating to Chemical Technology.

A. Searing of hard rocks to enable them to be cut (or pulverised) (*सूत्रिक*).

Sprinkle on the rock taken red-hot from the fire of Palasa and Tinduka wood (*Butea Frondosa* and *Diospyros Embryopteris*) :—(a) diluted milk, or (b) a solution of wood ashes (the ashes of the *Mokshaka* mixed with those of reeds), or (c) a decoction of (the fruit) of the jujube (*Zizyphus Jujube*) kept standing for 7 nights in a mixture of whey, vinegar and spirits, in which *Kulattha* (*Dolichos Uniflorus* or *Biflorus*) has been steeped, or (d) a solution of the ashes of the *Neema* bark and leaves (*Azadirachta Indica*), the sesame pod, the resinous fruit of the *Diospyros Embryopteris*, and the *Guduchi* (*Tinospora Cordifolia*) with cow's urine. Repeat the process seven times (in the last case six times).

(Varahamihira, *Vrihat-samhitā*, Chap. 33,
Stokas 112-117).

B. Hardening of steel (*सखपात्र*).

(1) Plunge the steel red-hot into a solution of plantain-ashes in whey, kept standing for 24 hours ; then sharpen on the lathe.

(2) Make a paste with the juice of the Arka (*Calotropis Gigantea*), the gelatine from the horn of the sheep, and the dung of the pigeon and the mouse ; apply it to the steel after rubbing the latter well with (sesame) oil. Plunge the steel, thus treated, into fire ; and when it is red-hot, sprinkle on it water, or the milk of the horse (or the camel or the goat), or ghee (clarified butter), or blood, or fat or bile. Then, sharpen on the lathe.

(Varāhamihira, *सूक्तसूत्रसूत्रम्*,
chap. 49, slokas 23-26.

C. Preparation of cements (for rocks, metals, etc.) (*सङ्गलेप*)—

Varāhamihira gives the following recipes among others. (1) First, prepare a levigated powder with lac, the resinous exudation of the *Pinus Devadara*, the *Balsamodendron Mukul*, the *Feronia Elephantum*, the kernel of the fruit of the *Egle Marmelos* (the *bel*), the *Diospyroa Embryopteris*, the *Neem* (*Azadirachta Indica*), the *Mhow* (*Bassia Latifolia*), the Indian madder (*Rubia Manjistha*), the *Phyllanthus Emblica*, and the resin of the *Sala* tree (*Shorea Robusta*), then make a decoction of this in 256 *Palas* of water reduced

by boiling to 32 Palas, and apply the decoction hot.

(2) The horns of cows, buffaloes and goats, asses' hair, buffalo's skin, with *gavya* (cow's urine etc.), the Neem (*Azadirachta Indica*) and the *Peronia Elephantum*, similarly treated.

(3) A mixture of eight parts of lead, two of 'bell-metal' and one of brass, melted and poured hot (Maya's cement).

The first, it will be seen, has lac, gum and turpentine as principal ingredients, the second makes use of gelatine, and the third is a metallic cement.

D. Nourishment of Plants :—(from Varāhamihira, Chap. 54, on पशुवैद्य).

The most suitable ground to plant in is soft soil that has been sown with the *Sesamum Indicum*, and dug up or trodden over with the sesame in flower. Grafts should be smeared with cowdung. For transplanting, the plants should be smeared with ghee (clarified butter), sesame oil, the honey of the *Kshudra* variety of the bee, the oil of the *Usira* (*Andropogon Laniger* or *Andropogon Citrarum*), the *Vidanga* (*Embelia Ribes*), milk and cowdung. Trees should be planted at intervals of 20 or 16 cubits.

As a sort of general prophylactic, mud kneaded with ghee (clarified butter) and *Vidanga*, (*Embelia Ribes*) should be applied to the roots, after which

milk diluted with water should be poured. As a remedy against barrenness, a hot decoction should be made of Kulattha (*Dolichos Uniflorus* or *Biflorus*), Masha (*Phaseolus Roxburghii*), Mudga (*Phaseolus Mungo*), Tila (*Sesamum Indicum*), and Yava (barley); which, when cooled, should be poured round the roots.

To promote inflorescence and fructification, a mixture of one A'dhaka (64 palas) of sesame, two A'dhakas (128 palas) of the excreta of a goat or sheep, one Prastha (16 palas) of barley powder, one Tula (100 palas) of beef, thrown into one Drona (256 palas) of water, and standing over for seven nights, should be poured round the roots of the plant. The measures given are for one plant.

To ensure inflorescence, etc., the seed before being sown should be treated as follows :—The seeds should be taken up in the palm greased with ghee (clarified butter), and thrown into milk;—on the day following, the seeds should be taken out of the milk with greased fingers, and the mass separated into single seeds. This process is to be repeated on ten successive days. Then the seeds are to be carefully rubbed with cowdung, and afterwards steamed in a vessel containing the flesh of hogs or deer. Then the seeds are to be sown with the flesh, with the fat of hogs added, in a soil previously prepared by being sown with sesame and dug up or trodden down.

To ensure the formation of Ballaris (i.e., sprouting and the growth of luxuriant stems and foliage), the seeds should be properly soaked in an infusion of powdered paddy, *Masha* (bean), sesame and barley mixed with decomposing flesh, and then steamed with *Haridra* (turmeric). This process will succeed even with the *Tintidi* (*Tamarindus Indica*). For the *Kapittha* (*Feronia Elephantum*), the seeds should be soaked for about two minutes (lit. such length of time as it would take one to make a hundred rhythmic claps with the palms *नमस्कार*) in a decoction of eight roots (*A'ephota*, *A'malak*, *Dhava*, *Vasika*, *Vetasa*, *Suryyavalli*, *Syama* and *Atimukta*, i.e., the *Jasmine*, the *myrobalan*, the *Grislea Tomentosa*, the *Justicia Ganderusea*, the *Calamus Rotang*, the *Gymandropsis Pentaphylla*, the *Echites Frutescens*, and the *Dalbergia Onjeinensis*) boiled in milk. The seeds should then be dried in the sun. This process should be repeated for thirty days. A circular hole should be dug in the ground, a cubit in diameter and two cubits deep, and this should be filled with the milky decoction. When the hole dries up, it should be burnt with fire, and then pasted over with ashes mixed with ghee and honey. Three inches of soil should now be thrown in, then the powder of bean, sesame and barley, then again three inches of soil. Finally, washings of fish should be sprinkled, and the mud

should be beaten and reduced to a thick consistency, then the seed-previously prepared should be placed in the hole under three inches of soil, and fish-washings poured. This will lead to luxuriant ramification and foliage, which will excite wonder. The Agnipurāna adds that the mango is specially benefited by cold fish-washings (मत्सीदकेन शीतलं आम्रादां शीतं पचते—इत्यादिर्द्ध, Agnipurāna). It will be seen that these elaborate recipes are empirical contrivances for supplying the requisite nitrogen compounds, phosphates and bacteria, these being potentially contained in the mixtures and infusions prescribed.

SANSKRIT TEXTS.



Extracts from RASARATNAKARA.

नागार्जुन-विरचितात्

रसरत्नाकरादुद्धृताः श्लोकाः ।

अथ महारसशोधनं व्याख्यास्यामः ।

किमत्र चित्रं यदि राजवत्तेकं

शिरोषपुष्पाग्रसेन भावितम् ।

सितं सुवर्णं तरुणाकंसन्निभं

करोति गुञ्जाशतमेकगुञ्जया ॥ १ ॥

राजावर्त्तशोधनम् ।

किमत्र चित्रं यदि पीतगन्धकः

पलायनिर्ध्वंसरसेन शोधितः ।

आरण्यकैरुत्पलकैस्तु पाचितः

करोति तारं त्रिपुटेन काञ्चनम् ॥ २ ॥

गन्धकशुद्धिः ।

किमत्र चित्रं रसको रसेन

* * * * *

क्रमेण कृत्वा मधुधरेण रञ्जितः

करोति शुक्लं त्रिपुटेन काञ्चनम् ॥ ३ ॥ *

रसकगोधनम् ।

किमत्र चित्रं दरदः सुभाषितः

पथेन[†] मिथ्या बहुशोऽस्त्रवर्गेः ।

सितं सुवर्णं बहुधर्मभाषितं

करोति साक्षादरकुटुम्बप्रभम् ॥ ४ ॥

दरदशक्तिः ।

कुलस्य कोद्वक्त्राद्ये नरमूत्रेण पाशयेत् ।

वैतसायनवर्गेण दत्त्वा चारं पुटत्रयम् ॥ ५ ॥

किमत्र चित्रं कदलीरसेन

सुपाचितं सुरणकन्दसंख्यम् ।

* Agrees nearly with Rasārṇava ; cf. Vol. I, Sans. Texts, p. 13.

† पथेन is the correct form.

वातारितैलेन घृतेन ताप्यं

पुटेन दग्धं वरशुद्धिमेति ॥ ६ ॥

माषिकशोधनम् ।

द्विगुणा विमला पय्या रश्मातोयेन संयुता ।

लवणैर्वर्कैर्दुग्धेन ताम्रपत्राणि लेपयेत् ॥ ८ ॥

चम्पौ सन्तप्य निर्गुण्डीरससिक्तानि समधा ।

भामान् वसुरसेनैव शुक्लशुद्धिर्भविष्यति ॥ १० ॥

परतः सर्वलोहशोधनम् ।

अम्लवेतसधान्याम्लमेघोतोयेन शुध्यति ॥ ११ ॥

विमलशुद्धिः ।

चपलाद्या धातवः सर्वे जम्बोररसभाविताः ।

शोधितास्त्रिदिनं पञ्चमृत्तिकाभस्मलावणैः ।

संयुताः संशोधयन्ति पुटपाकेन काञ्चनम् ॥ १२ ॥

हेमशोधनम् ।

नागेन जारराजेन क्षापितं शुद्धिसूच्यते† ।

* The text reads वक्, which is incorrect.

† This verse also occurs in Rasārṇava.

तारं त्रिवारनिक्षिप्तं पिशाचीतैलमध्यगम् ॥१३॥

तारशुद्धिः ।

अहो नु चित्रं पृथिवीभवेन

क्षारेण मेषीपयसा घृतेन ।

तैलेन शुद्धं द्रुतघोड्यांशं

भवेच्च शुद्धं शशिशृङ्गसन्निभम् ॥१४॥

मोक्षमारीटपालाय-क्षारगोमूत्रभाषितम् ।

वज्रकन्दशिखाकल्क-फलमूलसमन्वितम् ॥१५॥

तत्कल्कं कण्टकं साक्षाच्चूर्णं वैकान्तसम्भवम् ।

सारधेय* समायुक्तं मेषशृङ्गौदवान्वितम् ॥१६॥

पिष्टितं सूकमुषाख्यं धामितश्च हठान्मिता ।

तत्रैव पतते सर्वं वैकान्तस्य न संशयः ॥१७॥

वैकान्तमत्स्यम् ।

क्षौद्रं गन्धर्वतैलं सघृतमभिनवं

गो रसं मूत्रकञ्च

* These couplets also occur in R. R. S., with this difference that in the latter सवसार has been substituted for सारधेय.

भूयो वातारितैलं कदलिरसयुतं
भावितं कान्तितप्तम् ।

मूषां कृत्वाम्बिवर्णामरुणकरनिभां
प्रक्षिपेन्नाक्षिकेन्द्रं

सत्त्वं नागिन्द्रतुल्यं पतति च महता
सूर्यवैष्णवरामम् ॥ २५ ॥ *

महाद्विजार्कचौराभ्यां क्षीस्तन्येन सुभावितम् ।

मूषायामम्बिवर्णायां द्वैताप्यं न संशयः ॥ २६ ॥

ककुटद्विजाभ्याञ्च ताप्यं स्त्रीस्तन्यमर्हितम् ।

पश्चात्सत्त्वं निपतति सत्त्वं मूषा तु यस्मिन्वत् ॥ २७ ॥

काञ्जिकं बहुशस्त्रिणं ताप्यचूर्णं कटुलिकम् ।

कृत्वाम्बुमधुभ्यां पक्वं वज्रपायसभावितम् ॥ २८ ॥

गृहधूमं घृतं क्षौद्रं संयुतं पुनरेव च ।

धामितं मूकमूषायां शशिशल्बनिभं भवेत् ॥ २९ ॥

कदलीरसयुतभावितं घृतमध्वेरण्डतेलपरिपक्वम् ।

ताप्यं सुचति सत्त्वं रसकक्षैव त्रिसङ्घाते ॥ ३० ॥

माक्षिकसत्त्वपातनविधिः ।

* Cf. Rasārṇava, Vide Sans. Texts, Vol. I, p. 12

चारस्रैह्य धान्यान्ने रसकं भावितं वट्ट ।

ऊर्णा लाक्षा तथा पथ्या मूलता भूमसंयुतम् ॥ ३१ ॥

मूकमूपागतं भातं टङ्कणेन समन्वितम् ।

सत्त्वं कुटिलसङ्काशं पतते नात्र संशयः ॥ ३२ ॥ *

रसकसत्त्वम् ।

विमलं शिथलीयेन काक्षीकासौसटङ्कणैः ।

वज्रकन्दसमागुलं भावितं कदलीरभैः ॥ ३५ ॥

माक्षीकक्षारसंयुक्तं धामितं मूकमूपके ।

सत्त्वं चन्द्रार्कसङ्काशं पतते नात्र संशयः ॥ ३६ ॥†

विमलसत्त्वम् ।

दरदं पातनायन्त्रे पातितञ्च जलाशये ।

सत्त्वं मूलकसङ्काशं जायते नात्र संशयः ॥ ३७ ॥

दरदसत्त्वम् ।

गन्धकश्च प्रभावेण सत्त्वभूर्यं स्वभावतः ।

* Cf. Rasārnava, Benares MS. V. 37—38.

† Cf. Sans. Texts, Vol. I. p. 12. R. R. S. Bk. ii, 103—104.

ततः ख्यातं महासत्त्वं रसीन्द्रस्य सप्तं ततः ॥ ३८ ॥

अश्वकादिसत्त्वपातनविधिः ।

* * * *

एक एव महाद्रावो पार्श्वतोनाथमश्वः ।

किं पुनस्त्रिभिः संयुक्ता वेतसान्नाम्नकास्त्रिकैः ॥ ५० ॥

मुष्काफलानि सप्ताहं वेतसान्नेन भावयेत् ।

पुटपाके ततश्चूर्णे द्रवते सलिलां यथा ।

कुसुते योगराजोयं रत्नानां द्रावणे परम् ॥ ५१ ॥

अश्वकादिद्रुतपातनविधिः ।

तालैश्च वङ्गं दरदेद तीक्ष्णं

नागैश्च जैमं शिलाया च नागम् ।

गन्धाश्मना चैव निहन्ति शुल्बं

तारश्च माञ्जीकरसेन हन्यात् ॥ ५२ ॥

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शुल्बम् अजाक्षीरसुगन्धकेन

तारं सुहीक्षीरसुमाक्षिकेण ।

यद्यस्य धातोर्विहितश्च युक्तं

निरुत्यघातं कथितश्च तीक्ष्णैः ॥ ५४ ॥

मृतानि लोहानि रसौभवन्ति
 रसेन युक्त्यामयनाग्रानि ।
 अभ्यासयुक्ताः पलितादिनाशं
 कुर्वन्ति तेषाञ्च जराविनाशम् ॥ ५४ ॥

इति नागार्जुनविरचिते रसरत्नाकरे वज्रमारण-
 सत्त्वपातन-अभ्रकादिद्रावण-वज्रलोह-
 मारणाधिकारो नाम द्वितीयः ।

अथातो रसबन्धाधिकारं व्याख्यास्यामः ।

जम्बीरजेन नवसारघ्नास्त्वग्नौः
 चाराणि यच्च लवणानि कटुत्रयञ्च ।
 शिशूदकं सुरभिसूरणकन्द एभिस्-
 संमर्दिती रसनृपखरतेष्टलोहान् ॥ ५५ ॥

चारणजारणविधिः ।

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प्रज्ञापारमिता निशीथममये स्वप्ने प्रमादीकृतं
 नास्तीति चक्षुःमुखं रसेन्द्रममलं नागार्जुनप्रोदितम् ॥ ५६ ॥

• • • • •

रसं हेमसमं मथ्यै पौठिकागिरिगन्धकम् ।
 द्विपदौरजनीरश्मां मर्दयेत् टङ्गणान्विताम् ॥१०॥
 नष्टपिष्टञ्च मुष्कञ्च चम्पूमुष्णा निधापयेत् ।
 तुषाङ्गघृष्टं दत्त्वा यावद्भस्मत्वमागतः ॥११॥
 भस्मणास्त्राधकेन्द्रसु दिव्यदेहमवाप्नुयात् ॥१२॥

* * * *

गर्भयन्त्रं प्रवक्ष्यामि पौठिकाभस्मकारकम् ।
 चतुरंगुलदोर्घेण विस्तारेण च त्राङ्गुलम् ॥६२॥
 सूषां तु मन्मथीं कृत्वा सुहृदां वर्त्तलां बुधः ।
 विंशभागन्तु लोहस्य भागमेकं तु शुक्ललोः ॥६३॥
 सुवस्त्रं पेषयित्वा तु तोयं दत्त्वा पुनः पुनः ।
 सूषालेपं दृढं बद्धा लोणार्धसृत्तिका बुधः ॥६४॥
 कषं तुषाग्निना भूमौ मृदुस्वेदेन स्वेदयेत् ॥६५॥
 सूतकस्य पलं गृह्यं तुर्यीयं साङ्गकं विधम् ।
 तत्समं गन्धकं शुक्लं चूर्णं कृत्वा विनिक्षिपेत् ॥६६॥
 कृत्वा कज्जलिकामादौ पलं दत्त्वा च गन्धकम् ।
 द्रुतपक्वञ्च तच्चूर्णं पचेदायसभाजने ॥६७॥

यावद्वत्त्वमायाति तत्क्षणात् तं विनिक्षिपेत् ।
 पुटं वा कदलीपत्रे सिद्धं पर्पटिकारमम् ॥८६॥
 द्वितीयपर्पटोरसः ।

प्रणिपत्य सर्वबुद्धान्
 (मदुचीधान्) सकलदोषनिर्मुक्तान् ।

वक्ष्ये सर्वहितार्थं
 कक्षापुटं सर्वसिद्धिकरम् ॥
 श्रीशैलपर्वतस्याग्रौ सिद्धौ नागार्जुनौ महान् ।
 सर्वसत्त्वोपकारी च सर्वभाग्यसमन्वितः ॥
 प्रार्थितो ददते शीघ्रं यच्च पश्यति यादृशम् ।
 दृष्ट्वा त्यागञ्च भोगञ्च सूतकस्य प्रसादतः ।
 सर्वसत्त्वानयाविधौ स्वरसेन तथैव च ॥
 तेषां मध्ये प्रधानञ्च रत्नघोषः प्रचारकः ।
 कृताञ्जलिपुटो भूत्वा नागार्जुनपुरः स्थितः ।
 पृच्छते रसकर्माणि विद्यादानं ददस्व मे ॥

श्रीनागार्जुन उवाच—

साधु साधु महाप्राज्ञ तुष्टोऽहं भक्तवत्सलः ।
 कथयामि न सन्देहस्तत्त्वया परिपृच्छताम् ॥

वलीपलितनायश्च तथा कालस्य ध्वंसनम् ।
यथा लोहे तथा देहे क्षमते नात्र संशयः ॥

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सत्त्वानां भोजनायाय साधिता वटयक्षिणी ।
हादयानि च वर्षाणि महाक्लेशः कृतो मया ॥
तत्कालदृष्टद्रव्याणां दिव्या वाणी मया श्रुता ।
चदृष्टप्रार्थिता पश्चादृष्टा त्वं भव साम्प्रतम् ॥

श्रीवटयक्षिण्युवाच—

साधु साधु महासिद्ध * * * *
किञ्चिन्प्रार्थय मे सिद्ध तत्सर्वं प्रददाम्यहम् ॥

श्रीनागार्जुन उवाच—

यदि तुष्टासि मे देवि सर्व्वदा भक्तिवत्सले ।
दुर्लभं त्रिषु लोकेषु रसवन्धं ददस्व मे ॥

शालिवाहन उवाच—

सुवर्णरत्नभाण्डारं कुमारी मदसुन्दरी ।
निवेदितो मयात्मा मे आदेशो देवि दीयताम् ॥
साधु साधु महाप्राज्ञ ममादेशप्रपालक ।
साधयामि न सन्देहो युष्मत्सत्त्वेन साधकम् ॥

पुनरन्यं प्रवक्ष्यामि साण्डव्येन यथा कृतम् ।
 रसोपरसयोगिनं सिद्धं स्रुतं सुसाधितम् ॥
 विहङ्गुस्त्वायनं नामं यथार्थकाश्चनं कृतम् ।

* * * *

शास्त्रं वशिष्ठमाण्डव्यं गुरुपार्श्वे यथा श्रुतम् ।
 तदहं सम्प्रवक्ष्यामि साधनञ्च यथाविधि ॥
 सहायशोभनाः प्राज्ञा निरालम्बा दृढव्रताः ।
 कुलीनाः पापहीनाश्च साधयन्ति जितेन्द्रियाः ॥
 कोष्ठिका वक्रनालश्च गोमयं सारमिम्बनम् ।
 धमनं लोहपत्राणि शौषधं कार्ष्णिकं विह्वम् ॥
 कन्दराणि विचित्राणि * * *
 सर्वमेलयनं कृत्वा ततः कर्म समारभेत् ॥

रत्नघोष उवाच—

साधयित्वा प्रयत्नेन कोटिविधौ महारसः ।
 शरीरेण विनैतेन सर्वं भवति निष्फलम् ॥

नागार्जुन उवाच—

कथयामि न सन्देहः साकाण्डेन यथा कृतम् ॥
 शार्दूलश्च घनत्वश्च चापल्यं गुरुतेजसः ।

यस्यैतानि न दृश्यन्ते तं विद्याद्गुरुसूतकम् ॥
 नानावर्णं भवेत्सूतं विद्याय घनचापलम् ।
 लक्षणं दृश्यते यस्य मूर्च्छितं तं वदन्ति हि ॥
 गुरुत्वमरणत्वं वा तेजो भास्करसन्निभम् ।
 अग्निमध्ये यदा तिष्ठेत् खोटवन्मस्य लक्षणम् ॥*

अथातो रसेन्द्रमङ्गलानि यन्त्रविधिः ।

शिलायन्त्रं, पाषाणयन्त्रं, भूधरयन्त्रं, वंशयन्त्रं,
 नलिकायन्त्रं, गजदन्तयन्त्रं, दोलायन्त्रं, अधःपातन-
 यन्त्रं, भुवःपातनयन्त्रं, पातनयन्त्रं, नियामकयन्त्रं,
 गमन(?)यन्त्रं, तुलायन्त्रं, कच्छपयन्त्रं, चाक्रीयन्त्रं,
 बालुकायन्त्रं, अग्निसौमयन्त्रं, गन्धकवाहिकयन्त्रं,
 मूषायन्त्रं, इण्डिकायन्त्रं, कम(?)भाजनयन्त्रं घोषा-
 यन्त्रं, गुडाभ्रकयन्त्रं, नारायणयन्त्रं, जालिकायन्त्रं,
 चारणयन्त्रम् ।

अथ प्रवक्ष्ये सुगुरुरूपदेशान्

यः पाटलाख्यस्य रसस्य वृद्धः ।

* Cf. Rasārṇava, Vide Sana. Text, Vol. I. pp. 17—18.

यस्य प्रभावात् सयमेककच्छ-
 ज्वरादिकुष्ठामयनिग्रहः स्यात् ॥
 निक्षिप्य खड्गे त्रिपुरान्तकस्य
 वीजं दिशुर्दार्ढ्यपलप्रमाणम् ।
 क्रायेण तस्य त्रिपुरोद्धवेन
 सम्यर्द्धयेत् त्रिदिनानि यावत् ॥
 कन्यारसेन त्रिदिनं ततश्च
 सप्तार्चिषा चाथ दिनत्रयम् ।
 चूर्णसिकाया रजनोरजेन*
 सम्यर्द्धितं तम् उपतोयधौतम् ॥
 शोणि प्रमाणान्यथ सप्तमञ्च
 सम्पातयेत् पातनयन्त्रयोगात् ।
 सम्पातितो निर्मलतामुपैति
 सर्वप्रयोज्योऽपि हितं प्रशस्तम् ॥
 पलं समादाय रसस्य तस्य
 शुल्यस्य शुद्धस्य च कर्षमेकम् ।

* The text seems to be incorrect.

कृत्वाष्टपिष्टौ विधिवत्तयोश्च
 गन्ध्यास्त्रचूर्णे द्विगुणश्च देयम् ॥
 छतप्रयोगेण विपाण्य पद्यान्-
 निक्षिप्य खड्गे परिमर्दितश्च ।
 निष्कश्च मातृं त्वमृतस्य दत्त्वा
 गुच्छाप्रमाणा गुटिका च कार्या ॥
 श्रीलोकनाथस्य विभोः प्रसादात्
 ज्ञातं मया पोटलिकाविधानम् ।
 * * * * *
 इति रसेन्द्रमङ्गलं समाप्तम् ।

Extracts from RASAHRIDAYA.

भगवद्गोविन्दपादविरचितात्

रसहृदयादुद्धृताः श्लोकाः ।

A = MS. from Nepal.

B = MS. from India Office Library, with a commentary, named "Bālānvayabodhikā."

C = MS. from Benares.

द्वितीयपटलादुद्धृताः श्लोकाः ।

[टीका—सूर्च्छितरसस्य उल्लापनसंस्कारमाह—]

अमुना विरचनेन हि सुविशुद्धो नागवक्त्रपरिमुक्तः ।

सूतः¹ पातनयन्त्रे समुत्थितः² काश्चिके कायात्³ ।

[टीका—अथ सूर्च्छितरसस्य पञ्चमोद्दिष्टपातनसंस्कारं स्पष्टयन्नाह—]

(1) A reads पात्र, which makes the sentence incomplete and the metre defective.

(2) A reads सुविशुद्धं, which is a tautology as well as a grammatical error.

(3) काश्चिकेन कायात् is the variant in B. This is a defective metre.

कृत्वा तु शुक्लपिष्टी⁹ निपात्यते नागवक्त्रशङ्कातः⁷ ।
 तस्मिन् दोषान् मङ्गा³ निपतति शुक्लस्तथा सूतः⁴ ॥
 अष्टाङ्गुलविस्तारं⁵ दर्शय⁶ दशाङ्गुलं त्वधोभाण्डम् ।
 कण्ठादधः समुच्छ्रितचतुरङ्गुलकण्ठलाधारम्⁸ ॥
 अन्तःप्रविष्टतलभाण्ड¹धदनलमग्ननिजमुखपान्ता² ।
 उपरिष्ठाक्षिपिटपटी¹⁰ देयोदरषोडशाङ्गुलविशाला ॥

(1) A reads शुक्लपिष्टिम्.

(2) निपात्यते नागवक्त्र शङ्का is the reading in A, which is incorrect as well as defective metre.

(3) A reads शुक्ल दशान्गुला.

(4) A reads शुक्ल, which is a tautology as well as a grammatical error.

(5) B reads अष्टाङ्गुलम् विलीक्ये, which destroys the metre.

(6) B reads दर्शय तु, wherein तु is redundant.

(7) B reads सम तचतुरङ्गुलं कण्ठलाधारम्, which mares the metre.

(8) A reads अन्तःप्रविष्टतलभाण्ड, which is a defective metre.

(9) B reads अन्तः, which is grammatically incorrect.

(10) A has उपरिष्ठाक्षिपिटपुटिन, which is senseless.

तस्मिन्नीर्द्धभाण्डे¹ निपातितः सकलदोषनिर्मुक्तः² ।
 सुतरां भवति रसेन्द्रो कौर्ण्यसोऽपि पात्नोऽसौ³ ॥
 कृत्वाय⁴ नष्टपिष्टं त्रिफलाशिखिशिष्टराजिकापटुभिः ।
 संलेप्य चोर्द्धभाण्डं दीप्तैरुपलैरधः पात्यः⁵ ॥
 अथवा दीपकायन्त्रे⁶ निपातितः सकलदोषनिर्मुक्तः ॥
 कच्छुप्रयन्त्रान्तर्गतं सूत्रायपीठस्य दीपिकासंख्यः ।
 यस्मिन्निपतति सूतः प्रोक्तं⁷ तद्दीपिकायन्त्रम् ॥

- (1) A reads तस्मिन् नीर्द्धभाण्डे, which is incorrect.
 (2) निपातितसकलनिर्मुक्तः, an incomplete variant in A.
 (3) A has an incorrect reading—वासनोर्द्धपपात्नोऽसौ.
 (4) This verse and the next two are not found in B.
 (5) A reads उपलैरधःपात्यः, which has no sense.
 (6) A has दीपकायन्त्रे.
 (7) A reads कच्छुप्रयन्त्रे अन्तर्गतेन, which is grammatically incorrect.
 (8) The word सूतः is not found in A, thus making the metre defective.

सप्तमः पटलः ।

[टोका—अथ विडविधानमारभ्यते—]

ग्रामं न मुञ्चति न वाञ्छति तच्च भूयः

काञ्चिद्गुणान्¹ भजति² नित्यमनुक्तमात्रात्³ ।

यज्जीर्यते प्रचुरकेवलवह्नियोगात्

तस्माद्विडैर्मुनिविडैः सप्त⁴ जारया स्यात् ॥

[टोका—विडविधानमाह—]

सौवर्चलकटकत्रयकाङ्क्षौ⁵ काशीसगन्धकौ च विडैः ।

शिघ्रो रसग्रतभावेऽस्ताम्बदलान्यपि हि जारयति⁶ ॥

[टोका—विडान्तरमाह—]

-
- (1) A reads काञ्चिद्गुणान्, which is incorrect.
- (2) B reads भजति.
- (3) अनुक्तमात्रात् is the variant in A.
- (4) A reads मुनिवह्निविह्, which seems to be incorrect.
मुनिविडैः means by seven विड, mentioned below.
- (5) A reads काञ्चि, which is incorrect.
- (6) A has शिघ्रो रसग्रतभावेऽस्ताम्बदलान्यपि हि जारयति,
which is incorrect as well as defective in metre.

सर्व्वैर्दग्धमूलकप्रतिगलितं सुरभिन्नुत्प्रेष' ।

शतभास्यं वल्लिवसया' तत्क्षयतो जाय्यते हेम ॥

[टीका—यद्य चारहृत्तुल्यमौषधीराह—]

कदलीपलाशतिल'निचलकनकसुरदालिवासुकरणाः ।

वर्षाभूवमौलक'सहिताः चारा यथा लाभम् ।

[टीका—चारविधानमाह—]

शानीय चारहृत्तान् कुसुमफलशिका-

त्वक्पलाशैरुपेतान्'

कृत्वाः खण्डयस्तान्' विपुलतरशिला-

पिष्टपात्रातिशुष्कान्' ।

(1) सर्व्वैर्दग्धमूलकं रसविप्रतिगलितसुरभिन्नुत्प्रेष, a variant in A, which has no metre at all.

(2) A reads शतभा/वतरवनसया, which has no sense.

(3) तिल is not found in B.

(4) A reads साचौक, which seems to be incorrect.

(5) कुसुमफलशिकापनकैरुपेतान् is an incorrect text in A.

(6) A reads कृत्वा तत्क्षयं वसस्तान्, which is incorrect.

(7) A has विपुलतरशिलाष्टगनातिशुष्कान्.

दग्धं काण्डैस्त्रिलानां करिसुरभिहया-
 श्रोभिरासाव्य वस्त्रैः¹
 भस्म त्यज्जा जलं तत्² सृष्टुमिच्छिनि पचेत्
 हंसपाकीन भूयः³ ॥

[टीका—चारजलपाकलक्षणमाह—]

तच्छुष्यमाणं हि सवास्यनुदनुदान्
 यदा विधत्ते⁴ क्षणभङ्गान् गच्छन् ।
 तदा क्षिपेत् क्षूयण⁵ हिङ्गुगन्धकं
 चारचयं सप्तवर्णानि भूषणम्⁶ ॥

(1) A reads करिसुरभिहयीहाल्लानां च सूत्रे.

(2) A reads हं, which is incorrect.

(3) A reads वायन्.

(4) A reads erroneously पचा वदते.

(5) A reads क्षिपेत्क्षूयण. B reads क्षिपेत्क्षूयण. Both the readings are incorrect.

(6) A has चारचित्तं पटुलवर्णं भूषणम्, which mars the metre.

दृष्ट्याणि समिन्ध्र निवृत्य भूतसे
व्यवस्थितान्धसिकटोरिकापुटे¹ ।
संस्थापयेत् समदिनानि धान्यगं
ततः प्रयोज्यं रसजारणादिकम् ॥

[टीका—जारणार्थं चारविधानमाह—]

जम्बीरबीजपूरक² चाङ्गेरोवेतसाम्नसंयोगात् ।
चारा भवन्ति नितरां गर्भद्रुतिजारणे शक्ताः³ ॥

[टीका—रसे विडयोजनमाह—]

विडमधरोत्तरमादौ दृष्ट्वा सूतस्य चाष्टमांशेन⁴ ।
कुर्वाण्यारणमेवं क्रमक्रमानुद्वेयेदस्मिन्⁵ ॥

(1) A reads व्यवस्थितान् ससिकटोरिकामुले । B reads व्यवस्थितान्धसिकटोरिकापुटे ।

(2) A reads बीजपूरक, which is incorrect. The word बीजपूर is not found in B.

(3) गर्भद्रुतिजारणा शक्ता is an incorrect variant in A.

(4) A has दृष्ट्वा सूतं चाष्टमांशेन, which is not correct as it destroys the metre as well as the sense.

(5) A reads नद्वेयेदस्मिन्, which is grammatically incorrect.

अष्टमः पटलः ।

[टीका—अथ रसरामोऽभिधास्यते—

अभ्रकजीर्णस्य कायाविशेषमाह—]

जीर्णाभ्रको^१ रसेन्द्रे

दर्शयति^२ घनानुकम्पिनीं कायाम्^३ ।

कक्षां रक्तां पीतां

सितां^४ तथा सङ्करं मिश्राम्^५ ।

(1) A reads जीर्णाभ्रक, which mars the metre.

(2) A reads दुर्दृश्यति, which is incorrect.

(3) घनानुकम्पिनी काया is the variant in A. घनानुकम्प-
काया is the variant in B. Both the readings seem to be
incorrect.

(4) कक्षां रक्तां पीतां सितां is the reading in A, which is
incorrect.

(5) A reads ददा संकरीन्धिया, which is incorrect.

[टीका—अभ्यर्चयामाहर्णविशेषमाह—]

कृष्णाभकेण बलवत्¹ सितरामैर्गुण्यते² रसेन्द्रसु ।

शेतै रत्नैः पीतैः वज्रैः खलु वर्णतो ज्ञेयः³ ॥

[टीका—अथ रञ्जितरसप्रशंसामाह—]

अथ निजमेव हि वर्णे⁴

न जहाति यदा स रज्यते⁵ रागैः ।

कमशो हि मद्यमाणो⁶

निर्निज्ञो⁷ रञ्जनं कुरुते ॥

(1) वेताभकेण बलवत् is the variant in A, which is incorrect.

(2) A reads सितरामैः पूर्यते.

(3) A has रञ्जितसु श्रेयः, which has no clear sense. B has रञ्जितवर्णतो ज्ञेयः, which mars the metre.

(4) B reads अथ निजकर्मवशं, which is not correct.

(5) A reads यदा रसजीर्यते, which is grammatically incorrect.

(6) A reads मद्यमाणा, which is incorrect. B reads कमशो बलमाणी, which is also incorrect.

(7) A reads गारुडो.

[टोका—अभ्रसत्त्वादीनां योगे रसे व्यवस्थामाह—]

बलमास्तेभ्यकसत्त्वे जारणरागाः प्रतिष्ठितास्तौच्छे^१ ।

बन्धस्य सारलोहे^२ सारणमथ^३ नागवक्राभ्याम्^४ ॥

[टोका—सर्व्वकरणं तीक्ष्णमाह—]

क्लामति तीक्ष्णेन रसः तीक्ष्णेन^५ जीर्य्यते क्षणाद्वासः^६ ।

हेस्रो योनिस्तौच्छे^७ रागान् गृह्णाति तीक्ष्णेन ।

[टोका—तीक्ष्णहिङ्गुलयोगेन गुणाधिक्यमाह—]

तदपि च दरदेन हतं हत्वा माक्षीकेण रविसहितम्^८ ।

वासितमपि वासनया घनवच्चार्थ्यं^९ जार्थ्यं^{१०} ॥

-
- (1) A reads erroneously प्रतिष्ठितः तीक्ष्णः.
 (2) A reads सारवक्राहेः, which is incorrect.
 (3) A reads क्लामकमथ.
 (4) B reads नागवक्रमथ.
 (5) A reads तीक्ष्णे च.
 (6) A reads वासि, which is incorrect.
 (7) A reads योनिस्तौच्छे, which has a defective metre.
 (8) B has omitted हत्वा माक्षीकेण रवि.
 (9) A reads घनवच्चार्थ्यं, which is incorrect.

[टौका—तौच्छवदेनानाह—]

कान्तं वा तौच्छं वा काङ्क्षीं वा वज्रसस्यक वापि¹ ।

एकतमं सर्व्वं वा रसरजने सङ्करोऽभौष्ट² ॥

[टौका—स्वे स्वे विकारि वक्ष्यमाणमाह—]

कुटिले³ बलमप्यधिकं रागस्तीच्छे तु पन्नगे स्नेहः⁴ ।

रागस्नेहवलानि तु कमले शंसन्ति धातुविदः⁵ ॥

सर्व्वैरभिर्लोहैर्माञ्चिकसहितैर्मृत्तस्तथा गर्भे ।

विद्ययोगेन तु जीर्णो रसराजो विद्यति लोहेषु⁶ ॥

[टौका—रसवस्थानां मारणे विधानमाह—]

तालक⁷दरदशिलाभिः स्नेहचाराम्बलवणसहिताभिः ।

(1) काङ्क्षीं वा वज्रसस्यकादीनां, a variant in B.

(2) रसेषु हि रसावने विद्यते, a variant in A.

(3) This is not found in B.

(4) A reads erroneously पन्नगस्नेह.

(5) A reads धातुविदं, which is incorrect.

(6) This sloka is not found in B.

(7) A reads तारक.

समकदिगुणत्रिगुणान् पुटी वहेदङ्गशलादीन् ।

[टोका—पुटितधातुक्त्यमाह—]

रक्तस्नेहनिषेकैः सेकं^१ कुर्याद्दसस्य पिष्टिरियम् ।

चारणजारणमात्रात् कुरुते रसमिन्द्रगोपनिभम् ।

[टोका—सुख्यत्वेन ताम्रप्रशंसनमाह—]

यथवा^२ केवलममलं कमलं द्रवदेन वापितं कुरुते ।

त्रिगुणं जौरी^३ जौरी^३ लाचारससन्निभं सूतम् ॥

[टोका—विध्यन्तरमाह—]

रक्तगणमलितपशुजल-

बहु^४ भावितताप्यगन्धकशिलानाम् ।

(1) निषेकदीरङ्गः शलादीन्, a variant in A, which has a defective metre.

(2) B reads यथ.

(3) A reads हस्तिर्, which is incorrect.

(4) B reads erroneously चय.

(5) त्रिगुणं हि जौरीजौरी, a variant in B.

(6) The word बहु is omitted in B, which renders the metre defective.

(7) A reads गन्धकशिलानि.

एकेन वापितमृतं¹

कमलं रञ्जयति रसराजम् ।

[टोका--रसाधिकारि-गन्धकादीनाह--]

वाङ्मो गन्धकरागो² विलुलितरागे³ मनःशिलाताले ।

माद्यौक⁴सत्त्वरसकौ द्वावेतौ⁵ रञ्जने शस्तौ ।

[टोका--प्रधानयोः ताम्रखर्परयोः सत्त्वमाह--]

कमलद्वैः रविरसकेः⁶ संशुद्धौ सूक्ष्मसूचिकाभातः⁷ ।

(1) A reads वापितमृतं, which seems to be incorrect.

(2) A reads गन्धकराग, which is incorrect.

(3) A reads विलुलितरागे. B reads विलुलितरागेण. Both the readings are grammatically incorrect.

(4) B reads माद्यौक, which mars the metre.

(5) B reads द्वावे हि, which seems to be incorrect.

(6) A reads कमलद्वैः रविरसकेः. B reads कमलद्वौ रविरसकौ.

We have adopted the above reading after collating the texts.

(7) सूचिकासूचिकाभातः, a variant in A, which mars the metre. सूक्ष्मसूचिकाभातौ, a variant in B.

द्विगुणं जीर्णो जीर्णो¹ हेमाभी जायते² सूतः ।

[टोका—अभ्रकयोममाह—]

अयं क्षणाभ्रकचूर्णे घुटितं रत्नं भवेत्तथा³ प्रकलम् ।

द्विगुणं जीर्णो जीर्णो⁴ हेमद्वृत्तिसंनिभः सूतः⁵ ॥

[टोका—स्वर्णमारणमाह—]

द्विगुणेन मात्तिकेन तु कनकं च सूतं रसतालुयुतम्⁶ ।

पटुसहितं तत् पक्वं हृष्टिकया यावदिन्द्रगोपनिभम् ॥

(1) A reads जीर्णे जीर्णे. B reads जीर्णो जीर्णो.

(2) A reads घुटितसंनिभो भवेत्, (घुति - दुत). B reads द्विगुणोभी जायते, which mars the metre.

(3) A reads अयथा, which destroys the metre.

(4) A omits तथा.

(5) A reads जीर्णे जीर्णे, which seems to be incorrect. B reads जीर्णो जीर्णो.

(6) हेमद्वृत्ति(?)संनिभो भवेत् सूतः, a variant in A.

(7) कनकच रसतालुयुतं, a variant in A, which is a defective metre. The reading of B, which we have adopted, is also a defective metre. The word चैत् or खात् should be added after the word दुतम्.

[टीका—एतन्नखजौणं सूतस्य लक्षणमाह—]

तच्चूषे सूतवरे विगुणं जीये हि जीये तु ।

दुतहेमनिभः सूतो रज्यति लोहानि सर्व्वेषि ॥

[टीका—सब्बेषां धातूनां रसानामुत्तरोत्तरविशेषत्व-
माह—]

पवादष्टगुणं सत्त्वं सत्त्वादष्टगुणं द्रुतिः ।

दुतेरष्टगुणं बीजं तस्माद्वीजं तु जारयेत् ॥

(1) A reads लोये तु. B reads लीये हि.

(2) दुतहेमनिभवती, a variant in A, which seems to be incorrect.

(3) A has रजति लोहानि सत्त्वानि. B has रज्यति लोहानि सर्व्वेषि. Both the readings have defective metre.

(4) This verse is found in A after the verse तारक
दरद्विजाभिः &c. (vide ante pp 28—29) and runs thus :—

पवादष्टगुणं दत्त्वा सत्त्वादष्टगुणं द्रुतिः ।

दुतेरष्टगुणं बीजं तस्माद्वीजं तु जारयेत् ॥

नवमः पटलः ।

[टीका—बीजप्रशंसनमाह—]

इति रत्नोपि रसेन्द्रो बीजेन विना न कर्मज्ञदभवति ।

द्विविधं तत् पीतमितं^१ नियुज्यते सिद्धये च रसम्^२ ॥

[टीका—रसोपरसधातूनां बहुविधत्वात् शोधन-
माह—]

तस्य विशुद्धिर्बहुधा^३ गगनरसोपरसलोद्घूर्णैश्च ।

द्विविधं बीजं तैरपि नाशुहैः शुध्यते कदाचिदपि^४ ॥

[टीका—अशुद्धबीजप्रभावमाह—]

यः पुनरितैः कुरुते कर्मोऽशुद्धैर्भवेद्रसस्तस्य ।

(1) B reads पीतं द्वितं which destroys the metre.

(2) नियुज्ये सिद्धये च रसः, an incorrect variant in A. नियुज्यते सिद्धये च तत्, a variant in B. Both texts are collated in our adopted reading.

(3) रसति इतिमोक्षा, a variant in A, wherein the first term seems to be incorrect.

(4) B reads नैतत् instead of कदाचिदपि. This is incorrect ; since it contains two negatives.

अव्यापकः पतङ्गो¹ न रसे न रसायने योग्यः² ॥

[टीका—रससंज्ञकानाह—]

वैकान्तकान्त³सख्यकमाक्षिक⁴विमलाद्रिदरद-

रसकाच⁵ ।

अष्टौ रसास्तथेषां सत्त्वानि⁶ रसायनानि स्युः ।

[टीका—उपरससंज्ञकानाह—]

गन्धकगैरिकसुशिला⁷क्षितिखेचरमञ्जनश्च

कङ्कुष्ठम् ।

उपरससंज्ञमिदं⁸ स्वात् शिखिशिखौ सारलोहाख्यौ ॥

(1) अव्यापकपतङ्गि, a variant in A, which is incorrect.

(2) A reads योग्यो. B reads रसपदवने योग्यः. Both the readings are incorrect.

(3) A omits कान्त,

(4) A reads साक्षीक, which mars the metre.

(5) A reads दलदरसकैद.

(6) A reads चत्वारि, which is not accurate.

(7) B reads शिलासक, which destroys the metre.

(8) B reads संज्ञकमिदं, which mars the metre.

[टीका—पूतिसंज्ञके आह—]

ताम्बारतोच्छकान्ताभ्रवज्रलोहानि^१ नागवह्नौ च^२ ।
कथितौ च पूतिसंज्ञौ^३ तेषां संगोधनं कार्यम् ॥

[टीका—लवणचारसंज्ञे आह—]

सौवर्चलसेन्धवकं चूलिकसामुद्ररोमकदिहानि ।
पङ्कलवणान्येतानि तु सर्जयिवटङ्कणाः क्षाराः ॥^४

[टीका—शोधकद्रावकगणमाह—]

सूर्यावर्तः^५ कदली कन्या^६ कोशातकी च सुरदाली ।
शोण्य^७ वज्रकन्दो नीरकणा काचमाची च ॥
आसामिकरसेन तु लवणक्षारास्त्रिधाविता बहुधा ।
शुद्धान्ति रसोपरधा भाता सुहन्ति सत्त्वानि ॥^८

- (1) B reads सललोहानि.
- (2) B reads बह्नागौ च.
- (3) B reads कथितौ कुभृतसंज्ञौ, which is incorrect.
- (4) This verse is not found in A.
- (5) A reads सूर्यावर्तक.
- (6) B reads कन्या.
- (7) A reads शिण्य.
- (8) This verse is found in A only.

[टीका—शोधकद्रावकाणां शोधनद्रावणविधान-
माह—]

स्निग्धं सचारास्त्रैः^१ धातं वैक्रान्तकं हठाद्भवति^२ ।
तद् द्रुतमात्रं^३ शुध्यति कान्तं शशरत्नभावनया ॥

[टीका—तच्चाह—]

सस्यकमपि रत्नगणैः^४ सुभावितं खेहरागसंयुक्तम्^५ ।
शुध्यति वारैः^६ सप्तभिरतः परं युज्यते कार्थ्ये^७ ॥

[टीका—तच्चाह—]

चारैः खेहरादी पद्मादास्त्रेन^८ भावितं विमलम् ।

(1) A reads सचारास्त्रैः.

(2) A reads हठाद्भवति, which is incorrect.

(3) A reads द्रुतमात्रे, which is incorrect.

(4) B reads रत्नगणैः, which seems to be incorrect.

(5) भावनया: खेहरागसंयुक्तं, a variant in A.

(6) A reads वारैः.

(7) सप्तभिरतः परं योजयितुं कार्थ्ये, a variant in A, which
murm the metre. B reads सप्तभिरभितः परं, wherein अभितः
is incorrect as well as a defective metre.

(8) B reads पद्मात् त्रयेण.

शुध्यति तथा च रसकं दरदं माघीकमप्येवम्¹ ।

[टीका—ताम्रशोधनमाह—]

तनुरविपत्रं लिप्तं² लवणक्षाराक्षरविस्तृक्क्षीरेः³ ।

भातं निर्गुण्डीरससिक्तं बहुशो वहेद्द्रवत्वञ्च⁴ ॥

[टीका—लोहशोधनमाह—]

शुध्यति नामो वङ्गो घोषो रविणा च वारमुनिसंख्यैः⁵ ।

निर्गुण्डीरससेकैः⁶ स्तम्बूलरजःप्रवापैश्च ॥

[टीका—तमाह—]

(1) दरदमाघीकमप्येवं तथा इत्यादि, a variant in A, where-
in the last two words are superfluous and incorrect.

(2) B reads तनुरपि वनस्पतिः, which has no sense.

(3) A reads क्षुद्रि. B reads क्षुद्रा. Both the readings
destroy the metre.

(4) A reads बहुशो वहेद्द्रवत्वं. B reads बहुशो द्रवत्वञ्च.
Both the readings are defective.

(5) घोषो रविरीधमपि च मुनिसंख्यैः, a variant in A. B
reads रविणा च वारमुनिभिः. Both the readings are in-
correct.

(6) B reads द्विजैः, which is not correct.

रक्तगणगणितपशुलभाविपुटितं च रज्यते^१ लीखम् ।

शुभ्रति कदलीशिखिरसभाविपुटितं त्रिभिर्वारैः ॥

[टीका—सारणमाह —]

सर्वैः शुभ्रति लोहो रज्यति^२ सुरगोपसन्निभो वापात् ।

माजिकसत्त्वे भट्टं^३ शुल्वं वा गन्धकीनं हतम्^४ ॥

एकादशः पटलः ।

कागास्त्रिभस्मनिर्मितमूषां कृत्यैवामलकाकारां ।

दलयोगे घनरश्म्यां टंकणविषगुञ्जकतलेपां ।

(1) A reads रज्यते, which is incorrect.

(2) शुभ्रति कदलीशिखिरसभाविपुटितं, an incorrect variant in B.

(3) A and B read रज्यति, which is grammatically incorrect.

(4) A reads सत्त्वं. B reads दरदेन भः. Both are unintelligible.

(5) A reads शुल्वेन वा गन्धकीनं हतम्. B reads सत्त्वं.

[टीका—अथ अथकारयितुर्वंशवर्णनमाह—]

गौतांशुवंशसम्भवहैहयकुलजन्मजनितकुलमहिमा ।
अयति श्रीमदनरथः^१ किरातनाथो रसाचार्यः ॥

[टीका—अथ चास्य कारयितुर्गुणवर्णनमाह—]

यस्य स्वयमवतीर्णा रसविद्या सकलमङ्गलाधारा^२ ।
परमश्रेयसहेतुः श्रेयसि परमेष्ठिनः पूर्यम्^३ ।
येन चतुर्वर्ण्यं^४ स्रष्टादिव्याधादिसम्पत्तामम्^५ ।
दक्षिणरसा गृहीता^६ आदिवराहेणैव महाप्रकये ॥^७

(1) कुल is not found in B.

(2) स अयति श्रीमदनरथ, a variant in B.

(3) C reads सकलमङ्गलाधारा.

(4) Of the latter half C has only परं सहेतुः.

(5) C reads चतुर्वर्ण्यं स्रष्टादिव्याधादिसम्पत्तामम्, which seems to be incorrect. Cf. Patala I., in which the following verse is given :—किरातगोपादिकतामसाद्यमेवरासन्कुलमङ्गलाधारे ।
विदलि नालाविधमेवजाना प्रमाथयथोक्तहिनामजायते ॥

(6) दक्षिणरस गृहीता is the incorrect reading in C. [In the case of किरातनाथ रसः गृहीता; i. e. collected रस—mercury, minerals &c. and दक्षिण is favorable ; and in the case of आदिवराह रस गृहीता i. e. lifted up the earth.]

(7) This verse and the next are not found in B.

नटशरीरविवर्णा हीनाङ्गाः कुट्टिनो गुणादयस्य ।

अभिनवसोमेश्वरतामापुरपि पुनर्नवेरङ्गे ॥

[टीका—कर्त्ता स्वनाममहत्त्वं सूचयन्नाह—]

तस्मात् किरातनृपतेः बहुमानमवाप्य रससुकर्षीरतः¹ ।

रसहृदयाख्यं तन्त्रं² विरचितवान् भिक्षुगोविन्दः³ ॥

नम्रा मङ्गलविष्णोः सुमनोविष्णोः सुतेन तन्त्रोद्यम्⁴ ।

श्रीगोविन्देन कृतः⁵ तथागतः श्रेयसे भूयात् ।⁶

षष्ठादशसंस्कारं रसेन्द्रदेवस्य दिव्यतनुं दृष्ट्वा ।

लिखितमिदं पुण्यतमं रसहृदयमवाप्यते सकलम् ॥

(1) C reads रसकर्षीरदेवतो दृष्ट्वा, which destroys the metre.

(2) C reads रसहृदयेकमन्दं, which seems to be incorrect.

(3) C reads विरचितायां मनवद्गोविन्दः, which is incorrect.

(4) C has रसाटव्यनाम तन्त्रोद्यम्, which is incorrect.

(5) C has श्रीमदमनवद्गोविन्देन कृतं, which mars the metre.

(6) This verse and the next are not found in B.

इति श्रीमद्भगवद्गोविन्दविरचितं

रसहृदयं समाप्तम् ।'

शुभसम् ।

संवत् १६०४ समये ज्यैष्ठ्ये वदि १२ भौमि

जगन्नाथभट्ट लेखि ॥

श्रीराम ज्ञान संवत् १८८० पौष वदि १ भौमि ।

(1) MS. A ends abruptly with the colophon, which runs thus :—इति श्रीगोविन्दभगवत्पादविरचिते रसहृदये श्रीरस-
निवाधिकार एकविंशतितमः पटलः ॥ The author's account
of himself is altogether wanting in it. B has "इति रसहृ-
दयस्य कुलकिरीटभूषणमहाकाव्यपादपदप्रसन्नसकलविद्यापारीय श्रीमद्भग-
वद्गोविन्दस्य रसहृदयः समाप्तः । इति श्रीमत्कुरुक्षेत्रमय्योचिदुवाक-
मिदमहेशास्त्रसौचगुरुंजविरचितः ॥ स्वर्गे माता-
न्वयगोविन्दाख्यायां रसहृदयटीकायां रसवत्प्रसासक एकविंशोऽध्यायः ।
इति श्रीः" ॥

Extracts from KAKACHANDESVARIMATA.

काकचण्डेश्वरीमततन्त्रात्

समुद्धृताः श्लोकाः ।

ॐ नमः सदाशिवाय ।

कैलासशिखरासीनमुमा रुद्रं जगद्गुरुम् ।
क्रन्दनदौमन्ताकाली भृंगचण्डीविनायकी ॥ १ ॥
योगिनीनामष्ट तत्र युद्धाद्गुह्यतरं परम् ।
कपाली कालरात्री च कालचन्द्रकलाश्रिका^१ ॥ २ ॥
कराली कालकर्णी च काकचण्डेश्वरी तथा ।
एवमादिस्तथा चान्या योगिनीमण्युह्यकैः^२ ॥ ३ ॥

(1) The text reads कालचन्द्रकलाश्रिका, which is incorrect.

(2) The text reads गुह्यकौ, which is incorrect;

नृत्यवाद्यसुखेयानैः सानन्दैर्दृष्टचेतसैः ।
 तत्रस्थं भैरवं देवं योगिनौगणवेष्टितम् ॥ ४ ॥
 केचित् स्तुवन्ति संहृष्टाः केचिद्विद्वन्ति गुह्यकाः ।
 केचिन्नृत्यन्ति गुह्या ये केचिद्वाद्यं न कुर्वन्ते ॥ ५ ॥
 हृषितं^१ भैरवं देवं पञ्चवक्त्रं त्रिलोचनम् ।
 तं दृष्ट्वा भैरवीं हृष्टा जगतां त्रिदशेश्वरी ॥ ६ ॥
 कृताञ्जलिपुटा भूत्वा क्षणतारकलोचना ।
 काकचण्डेश्वरी देवी उवाचे^२ तु भैरवी ॥ ७ ॥

काकचण्डेश्वरी उवाच ।

भगवन् देवदेवेश सर्वज्ञ सर्वविच्छिन्न^१ ।
 सर्वज्ञानप्रकाशाय अहं पृच्छामि शंकर ॥ ८ ॥
 कथं कायस्थितो जीवो जीवकीर्णौ प्रकीर्तितः ।
 कायस्थः कर्मणा केन स्थितः संसारपञ्जरे ॥ ९ ॥
 जराश्याधिदारिद्रेण भक्तः संसारबन्धनैः ।
 एको ब्रजति यानेन एकः स्वर्धे वहेच्च तम् ॥ १० ॥

(1) The text reads हृषितं, which is not correct.

(2) The text reads उवाच, which is not correct.

जयजयशब्दं मांगल्यमेकस्थाने च जतवः ।

किं कुर्वाणाः प्रकुर्वाणाः कस्मान्मे ब्रूहि शंकर ॥ ११ ॥

श्रीसर्वज्ञ उवाच ।

शृणु त्वं काकचामुंडे साधकानां हितं प्रिये ।

गुह्याद्गुह्यतरं वाक्यं पृष्टोक्तं तु वरानने ॥ १२ ॥

कथयामि समासेन शृणु त्वं काकचंडिके ।

यस्यार्थश्च परो नित्यः अनादिनिधनेश्वरः ॥ १३ ॥

सुरुपो निर्गुणः शांती विश्वव्यापी परात्परः ।

अनादिकर्मसंबन्धः कायस्थो भवति तु सः ॥ १४ ॥

जीवे व्याधिभयं कर्म अज्ञानात् संप्रकीर्तितम् ।

तस्मात् कर्मभवात् क्लिष्टः संसारे संसरेत्तु सः ॥ १५ ॥

करोति^(१) द्विविधं कर्म संसारे काममोहितः ।

द्रव्योपायं न जानाति कामभोगार्थहेतुना ॥ १६ ॥

काय^(२)क्लेशेन मानस्यो द्रव्योपायं करोति सः ।

क्षयिष्याणिज्यसेवायां भेषाविक्रयविक्रये ॥ १७ ॥

(1) The text reads काकचंडिके, which is incorrect.

(2) The text reads करोतु, which is not accurate.

(3) The text reads कायक्लेशेन, which is not correct.

वहन्ति काष्ठभारांश्च दृष्ट्वा भारमनेकधा ।
 यानं यथनच्छत्^१ च किं करोति^२ करोति सः ॥ १८ ॥
 कामासक्तनरः शौमान् कुरुते कर्म नैकधा^३ ।
 कुर्वाणाश्च नराः केचित् कामासक्तार्थचिन्तकाः ॥ १९ ॥
 जायते मर्त्यलोकेऽपि न दारिद्र्योपहतचेतसः ।
 जायते नात्र संदेहो कुलखंजा नपुंसकाः ॥ २० ॥
 महासंसारबंधेन त्रिगुणेन सुयचिताः ।
 षट्स्थानां घोरसंघट्टघाटिकां तु नयन्ति तत् ॥ २१ ॥
 एतत्ते कथितं भद्रे यत्त्वं मां परिपृच्छसि ।
 किमन्यत् पृच्छसे भद्रे तथा ते कथयाम्यहम् ॥ २२ ॥
 इति काकचंडेश्वरौसते प्रथमः पटलः ।

श्रीकाकचण्डी उवाच ।

कथयस्व महादेव कामभोगप्रसाधनः ।
 अर्थः संपद्यते येन शक्तीयात् परमेश्वर ॥ १ ॥

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- (1) The text reads दशनद्वयं, which is incorrect.
 (2) The text reads किं कुरुते, which is incorrect.
 (3) The text reads कुरु कर्मनैकधा, which is incorrect.

तदहं श्रोतुमिच्छामि कथयस्व मयादतः ।
 आकाशगमनं देव श्वेचरत्वं यथा भवेत् ॥ २ ॥
 पादुकाया दले पंचदिव्यस्त्रीकामसाधनम् ।
 रोचनं शंजनं चैव धातुवाटरसायनम् ॥ ३ ॥
 जलूकाबंधमित्याहुः रसस्य मारणं कथम् ।
 जारणं रत्नकर्तृत्वं वज्रैर्भद्रावर्णं कथम् ॥ ४ ॥
 एतत् सर्वं समासेन ब्रूहि मे त्रिपुरांतक ।

श्रीभैरव उवाच ।

शृणु त्वं काकचामुंडे साधकानां हितं प्रिये ॥ ५ ॥
 कथयामि समासेन पृथक् मिदार्थसाधनम् ।
 न द्रव्येण विना सिद्धिर्न भोगाः काम एव च ॥ ६ ॥
 द्रव्यहीना नरा मर्त्ये प्रेतरूपेण संस्थिताः ।
 षटंति मर्त्यलोकिस्मिन् पर्युपद्रवकारणम् ॥ ७ ॥
 * * * दिवं (?) तेषां जायतोपि मृतमृतः ।
 कुलं सौभाग्यरूपं च पांडित्यं ज्ञानसंस्थितम् ॥ ८ ॥
 द्रव्यहीना न श्रीर्भर्ते प्राणहीना नरा यथा ।
 कुक्षितो ह्याणहीनोपि केनापि वधिराः स्थिताः ॥ ९ ॥

पद्यन्ते मर्त्यलोकेऽस्मिन् द्रव्यस्य मकरध्वजम् ।
 तस्मात् संसाधयेद्देवि रसेन्द्रं साधकोत्तमः ॥ १० ॥
 अथातः संप्रवक्ष्यामि रसेन्द्रसाधनं तव ।
 मारणं जारणाद्यं च द्रव्यसाधनमुत्तमम् ॥ ११ ॥
 वज्रदंडः सुदंडश्च लोहदंडस्तथैव च ।
 वयो विना ओषधये रसस्य मारणे हिताः ॥ १२ ॥
 तादृज्बोध समासेन यथा जानन्ति साधकाः ।
 वज्रदंडस्तु वज्री स्यात् लोहदंडं पुटं विट् ॥ १३ ॥
 सुदंडं ब्रह्मदंडं च समासात् कीर्तितं तव ।
 ग्राहयेत्तं समासेन साधको ज्ञेयमानसः ॥ १४ ॥
 तद्रसं रससंयुक्तं एकौकृत्य तु मर्दयेत् ।
 अंधमूषागतं धातं रसं स्त्रियेत तत्क्षणात् ॥ १५ ॥
 सहस्रवेधो कर्त्ता च ज्ञायते स महारसः ।
 मूषां संलेपयेत् तेन पुरागृह्य महीषधीः ॥ १६ ॥
 अंधयित्वाग्निमध्ये तु रतिदंघ्रिः अयं विधिः ।
 पश्चात् पलसहस्रैकं शुल्बस्य ग्राहयेद्बुधः ॥ १७ ॥
 अस्त्रवर्गं हतं शुल्बं चारुवर्गं हतं शुभम् ।
 वज्रीचौराकंचौरेण मर्दयेत् शतधा नरः ॥ १८ ॥

पुष्टं दद्यात् समासेन कालिकारहितं भवेत् ।
 मूषागर्भोदरे क्षिप्वा धामयेत् खदिरानलैः ॥ १८ ॥
 रसेन्द्रः क्षिप्यते तत्र तारं संजायते क्षणात् ।
 अथातः संप्रवक्ष्यामि मूषाबंधं यथा भवेत् ॥ २० ॥
 मृत्तिकाः ग्राहयेत् प्राज्ञस्तृणपाषाणवर्जिताः ।
 तुषादग्धास्त्रयो याज्ञा नृदभागास्तु त्रयस्तथा ॥ २१ ॥
 एकीकृत्य तु संबंधे मूषां तत् कारयेद्बुधः ।
 गोस्तनाकारसदृशोमथवामनकं कुरु ॥ २२ ॥
 मूषाबंधमिति स्थालं साधकानां हिताय वै ।
 अथान्यत् संप्रवक्ष्यामि रसस्य मारणं यथा ॥ २३ ॥
 ग्राहयेत् पूर्ववद्भूयः शीघ्रधीस्तिस्रः साधकः ।
 मूषां संलेपयेत् तेन धाम्य कर्म समाचरेत् ॥ २४ ॥
 रसेन्द्रो न्वियते क्षिप्रं कुरु कर्म यदिच्छया ।
 वीतोदकेन कामेन हेमकर्माणि वा शृणु ॥ २५ ॥
 कारयेन्नोहमयं पात्रं तस्योर्ध्वं मृन्मयं शुभे ।
 अन्योन्यपृष्ठसंलग्नं कारयेत् साधकोत्तमः ॥ २६ ॥
 अधोयन्त्रेण तं धाम्य आयसं तत्र जारयेत् ।
 तप्तजल्योदरे घृष्टं जरते नात्र संशयः ॥ २७ ॥

तद्गुणं आयसं तच्च हेमं चाष्टगुणं ददेत् ।
 क्षौरवज्रं तथा चारौ षट्जारौ उदिरयद्दौ । (?)
 याज्ञयित्वा रसं तेषां आयसं जारयेत्तरः ॥ २८ ॥
 हेमं संजायते तच्च धर्मकामार्थसाधनं ।
 गृह्य खण्डोदरे तद्धे हेमं षड्गुणतां भजेत् ॥ २९ ॥
 पुरा महीषधैर्युक्तं जरते नात्र संशयः ।
 जारितं सारितं दद्यात् पुनस्तं जारयेद्दयादि ॥ ३० ॥
 कुरुते कर्मसंघास्य कर्म सिद्ध्यर्थसाधनं ॥ ३१ ॥
 जारणं मारणं चैव समासात् कौत्सितं मया ।
 किमन्यत् पृच्छसे भद्रे तथा ते कथयाम्यहम् ॥ ३२ ॥
 इति श्रीकाकचंडेश्वरीमते द्वितीयः पटलः ।
 अथान्यं संप्रवक्ष्यामि अश्वकस्य यथाक्रमम् ॥ २० ॥
 द्रावणं अश्वकस्यैव समासेन विधीयते ।
 क्षौरकंचुकिचूर्णेन तद्रसेनाभिभाषितं ॥ २१ ॥
 निर्गुण्डीवज्रदण्डं तु तद्रसे भाषितं कुरु ।
 एकैकं सप्तवारैस्तु भावयेत् साधकोत्तमः ॥ २२ ॥
 (भावनान्ते) अश्वकस्य अस्त्रे क्षिपेद्दिनत्रयं ।
 ब्रह्मणा सप्तवारं तु क्षिपेदश्वं नरोत्तमः ॥ २३ ॥

तेन कल्केन पत्राणि लेपयेदम्बकस्य च ।
 कांस्यपात्रेण * * * स्तारं साधकोत्तमः ॥ २४ ॥
 सूर्यधास्त्रि ततो धाप्यः सप्ताहं साधकोत्तमः ।
 द्रवते नात्र संदेहः प्रियं दृष्ट्वा यथा स्त्रियः ॥ २५ ॥
 रसस्य भागमेकं तु द्रुतभागसमं कुरु ।
 एकौकृत्य तु तद्वास्यं म्रियते नात्र संशयः ॥ २६ ॥
 लक्षांशवेधकोऽसौ हि जायते नात्र संशयः ।
 अन्नान्धं संप्रवक्ष्यामि यथा संजायते द्रुतिः ॥ २७ ॥
 याहयेदम्बकं प्राञ्चः पीतं वा कृष्णमेव वा ।
 पुरा संस्कारयुक्तं तु कर्तव्यं साधकेन तु ॥ २८ ॥
 यथासा चित्रकं धारः कंचुकीवज्रदंडयोः ।
 वज्रकंदार्कशीरं च भस्मात् टंकणं तथा ॥ २९ ॥
 क्षारत्रयसमायुक्तं पट्पंचसमन्वितं ।
 एकौकृत्य तु कल्केन अम्बपत्राणि लेपयेत् ॥ ३० ॥
 मूषागर्भोदरे क्षिप्वा धामयेत् खदिरानलेः ।
 द्रवते नात्र संदेहो * * * * *
 इति काकचंडेस्त्रयीमते षष्ठः पटलः ।

Extracts from
RASENDRACHUDAMANI.
सोमदेवविरचितात् रसेन्द्रचूडामणेः
उच्यताः श्लोकाः ।

रूप्येण सह संयुक्तं धातं रूप्येण चैकगेत्^१ ।
तदा निरुत्यमित्युक्तं लोहं तदपुनर्भवम् ॥
एवं रूप्यं सनागं चेत् धातं ताम्रं लगेच्चहि ॥

निष्कमात्रे तु नागोऽस्मिन् लोहकार्यं कृते सति ।
स्वतो लक्षगुणां हैमीं शलाकां ससति भुवम् ॥
कुसुमैलतप्तं तत् स्वर्णमुद्गिरति^२ भुवम् ।
गुह्यनागोऽयमुद्गिहो वक्ति^३ स्वच्छन्दमैरवः ॥

(1) The text reads लघु. But रसरवसमुच्चय reads लगेत्, which seems to be correct.

(2) The text reads स्वर्णे मुद्गिरि, which is incorrect.

(3) The text reads मुद्गिरति, which has no sense.

तीक्ष्णं नीलाञ्जनोपेतं ज्ञातं हि बहुशो दृढम् ।
 सुदुर्लभं द्रुतद्राव¹ं वरनागं तदुच्यते ॥
 सतस्य पुनरुद्भूतिः संप्रीक्षोत्थापनाख्यया² ।
 द्रुतद्रव्यस्य निक्षेपो द्रवे तद्भालनं मतम् ॥
 चिंशत्पलमितं नागं भानुदुग्धेन मर्दितम् ।
 विमर्दय पुटयेत्तावत् यावत् कर्षावशेषितम् ॥
 न तत् पुटसहस्रेण क्षयमाद्याति सर्व्वथा³ ।
 चपलोऽयं समुद्दिष्टो वार्तिकैर्नागसम्भवः⁴ ॥
 इत्थं हि चपलः⁵ कार्थ्यो वङ्गस्यापि न संशयः ।
 तत्सृष्टहस्तसंसृष्टः केवलो बध्यते रसः ॥

(1) The text has द्रुतद्रावो, which is incorrect. We have adopted the text of रसवत्समुद्भव.

(2) The text reads साधीक्षोत्थापनाख्यया, which seems to be erroneous.

(3) The text has क्षयमाद्याति सर्व्वथा, which is grammatically incorrect.

(4) The text reads मर्दितसम्भवः, which is incorrect.

(5) The text reads इत्थं चौरपलः, which is senseless.

स रसो धातुवादिषु शस्यते न रसाद्यने¹ ।
 अर्थं हि स्वर्पणाख्येन² लोकनाथेन कीर्तितः ॥
 भ्रामकाख्यरजः सूक्ष्मं पञ्चमांशरसान्वितम् ।
 कुमारौसूलतोयेन मर्हयेदेकवासरम् ॥
 चाङ्गेरीश्वरसेनापि दिनमेकमनारतम्³ ।
 एवं भूनागधर्तरेण मर्हयेद्विषसद्वयम् ॥
 अथैकफलमानेन तावता त्रपुणापि च ।
 दशनिष्करसेन्द्रेण श्लक्ष्णपिष्टीं समाचरेत् ॥
 योजयित्वाय कल्केन यथापूर्वं विमर्हयेत् ।
 ततः साररसेन्द्रेण सत्त्वेन रसकस्य च ।
 पिष्टीं कृत्वा तु पूर्व्वेण पूर्व्वकल्केन योजयेत् ॥
 अथ प्रक्षाल्य कोण्डेन⁴ काञ्चिकेन प्रशोषयेत् ।

(1) The text has रसाद्यनम्.

(2) स्वर्पणाख्येन is the reading in रसरत्नसुत्रम्.

(3) The text reads दिनमेकमनारतम्, which has no clear sense.

(4) The text reads कोण्डेन, which is unintelligible.

पलाहंशुवसस्येन भट्टगुणारसेन च ।
 विमर्हं काष्ठीकं कुर्यात् मरिचप्रमितां गुटीम्¹ ॥
 निरुध्य वज्रसूषायां सन्धिवन्धं विधाय च ।
 शुषिरैर्नैवभिः² सम्मग्भस्त्राभ्यां च धमेत् खलु ॥
 ततो मूषागतं सत्त्वं समादाय समन्ततः ।
 धमेत् प्रकटसूषायां बहुनालेन शुद्धये ॥
 दशशाणं हि तत्सत्त्वं भस्मना लवणेन च ।
 सकाष्ठीकेन संवेद्य पुटयोगेन शोधयेत् ।
 द्विनिष्कप्रमिते तस्मिन् पूर्वप्रोक्तेन भस्मना ।
 अशीतिगुणितं नाम धात्वा निर्वाहयेत् खलु³ ॥
 इयता⁴ पूर्वसूतोऽसौ जीयते न कथञ्चन ।
 चपलोऽयं समुद्दिष्टो लोकनाथेन शम्भुना ॥
 अनेनापि रसः शीघ्रं बध्नेते पूर्ववत् खलु ।
 कारवल्लीजटाचूर्णैर्दशधा पुटितो हि सः ।
 भवेन्नागविनिर्गमो यासं गृह्णात्यशेषतः ॥

(1) The text reads मरिचप्रमिता गुटी, which is incorrect.

(2) The text reads द्विनिर्नैवभिः, which has no sense.

(3) The text reads इयता, which is incorrect.

सुखं प्रकटमूपायां भवेच्च विगुणोत्तरम्¹ ।
 जीर्णप्राप्तो रसोऽप्येव देहलोहकरो भवेत् ॥
 सोऽयं श्रीसीमदेवेन कथितोऽतौव निश्चितम् ॥
 भूभुजङ्गशक्तोयेः² प्रलाब्धापन्नते³ रजः ।
 कृष्णवर्णं हि तत् प्रोक्तं धौताख्यं⁴ रसवादिभिः ॥

स्वरूपस्य विनाशेन पिष्टतापादनं हि यत् ।
 विप्रद्विर्वर्जितः⁵ सूतो नष्टपिष्टः स उच्यते ॥
 अथ यन्त्राणि वक्ष्यन्ते रसतन्त्राख्यनैकशः⁶ ।
 समानोक्त्य समासेन सीमदेवेन सांप्रतम् ॥

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- (1) The text reads विगुणोत्तरा, which is incorrect.
 - (2) The text reads ताये, which is not accurate.
 - (3) The text has अपन्नते which is not accurate.
 - (4) The text reads धौताख्यं, which is not correct.
 - (5) But रसरजसमुच्चय reads विप्रद्विर्वर्जितः.
 - (6) But रसरजसमुच्चय reads अष्टमेव.

ऊर्ध्वपातनयन्त्रं हि नन्दिना परिकीर्तितम् ॥

कोहि(ष्टि)कायन्त्रमेतद्धि नन्दिना परिकीर्तितम् ॥

विम्ब्यादौ हिमपर्वते च मलये गोमन्तके श्रीगिरौ
सङ्घाद्रावथ पारियात्रकगिरौ किंकिंधिनामालये ।
माहेन्द्रेऽप्यथ चाल्पवत्क्षितिधरे तद्रूपनामाधिकं
गोपाभीरकसिद्धवेद्यसुखती वैद्यः समावेद्यताम् ॥

इति श्रीकरवालभैरवपुरवरपतिश्रीश्रीमदेवविरचिते

रसेन्द्रचूडामणौ रससूत्रस्थाने रसमहिम-

निरूपणं नाम प्रथमोऽध्यायः

समाप्तः ।

Extracts from
RASAPRAKASASUDHAKARA.

यशोधरविरचितात् रसप्रकाशसुधाकरात्
उद्धृताः श्लोकाः ।

विमलसूतधरो हि पलाष्टकं
तदनु धातुघटीपटकांतिकाः ।
पृथग्निमाद्य चतुःपलभागिकाः
स्फटिकशुद्धपलाष्टसमन्विताः ।
सह जलेन विमर्द्य च यामकं
लवणकान्जलेन विमिश्रितम् ।
उदितधातुगणस्य च मूर्धिकां
कुर्वन् रसं विनिवेशय तत्र व ।
उमरुकामिधयन्त्रवरेण तं
हिदययाममन्त्राचयवर्जिता ।
पवनपित्तकफक्षयकारकं
सकलरोगहरं परमं सदा ।

गजपतेर्बलवद्बलदो नृणां
 द्विजपतीश्वरवन्दनप्रदः ।
 युवतिकामविलासविधायको
 भवति सूतवरः सुखदः सदा ।
 सघनसाररसः किल कान्तिद-
 स्वखिलकुष्ठहरः कथितो मया ॥

इति कर्पूररसः ॥

उदयभास्करनामरसो ह्ययं
 भवति रोगविधान्तकरः स्वयम् ।
 मगधिकामधुना सह शुष्णिका-
 त्रयमितश्च सदा परिसेवितः ।
 ललितकामविलासविधायकः
 स्वविरकोऽपि रतौ तरुणायते ॥
 गदहरो बलदोऽपि द्वि वर्णदो
 भवति कर्मीविपाकजरोगहा ।
 सकलसूतकशास्त्रविमन्त्रजो
 द्विजवरेण मया प्रकटीकृतः ॥

इति उदयभास्कररसः ॥

अग्नेदानीं प्रवक्ष्यामि धातुशोधनमारणम् ।
 अनुभूतं मया किञ्चित् किञ्चिच्छास्त्रानुसारतः ॥
 सुवर्णं रजतं चेति लोहं शुद्धसुदीरयेत् ।
 ताम्रं चैवाश्मसारश्च नागवङ्गौ तथेव च ॥
 तीक्ष्णलोहं निगदितं हितयं रसवेदिभिः ।
 समिथलोहचितयं सौराष्ट्ररौतिवत्तकाः ।
 एतैःष्टौ धातवो ज्ञेया लोहान्येवं भवन्ति हि ॥

अथ रसकगुणाः ।

द्विविधो रसकः प्रोक्तः कार्ष्णिक-दुर्दरः¹ ।
 सस्वपाते परः प्रोक्तः प्रथमशौषधादिषु ॥
 स तु मेहहरश्चैव पित्तश्लेष्मविनाशनः ।
 रञ्जनः पारदस्याद्य नेत्ररोगक्षयादहः² ॥

(1) The text reads कालो ऋद्धदुर्दरः, which appears to be incorrect.

(2) The text reads सुव, which seems to be incorrect.

(3) The second hemistich is wanting in the text. We have adopted the reading of रश्मिरजसमुचय.

पारदो रसकसैव देहलोहकरावुभौ ।
 नागार्जुनेन कथितौ सिद्धौ येष्टौ रसावुभौ ॥
 कृतौ येनाग्निसहनौ सूतखर्परकौ शुभौ ।
 तेन स्वर्णसयौ सिद्धिरर्जिता¹ च न संशयः ॥
 रसको द्रावितः सम्यक् निज्जिमो रसपूरके ।
 निर्मलत्वमवाप्नोति समवारं निर्मज्जितः² ॥
 काञ्चिके वाघ तक्के वा नृमूत्रे³ मेषमूत्रके ।
 द्रावितं चालितं⁴ सम्यक् खर्परं परिशुध्यति ।
 खर्परं रेचितं शुद्धं स्थापितं नरमूत्रके ।
 रत्नयेन्मासमेकं हि ताम्रं स्वर्णप्रभं वरम् ॥

(1) The text reads सिद्धौ रजिता, which is not accurate.

(2) The text reads निर्मज्जितं, which is incorrect.

(3) The text has only मूत्रे, which mars the metre.

(4) द्रावितं चालितं is the reading of the text, which is evidently an error.

वचाइरिद्राचिफला-गृह्णमैः समैश्वरैः ।
 भस्मातकैश्चकैश्च चारैरास्त्रैश्च मर्दितम् ।
 पादाशंसंयुतैर्मेषां वृत्ताकफलमभिभाम् ।
 निरुध्य शोधयित्वा च मूषामुखोपरि न्यसेत् ॥
 प्रधाते खपरे ज्वाला सिता नीला भवेद्यदि ।
 लोहसंदंशकै मूषां वृत्त्वा कृत्वा ह्यधोमुखीम् ॥
 भूम्यामाढालयेत् सत्त्वं यद्यानालं न भण्यते ।
 तदा सौमोपमं^१ सत्त्वं पतत्येव न संशयः ॥
 अनेनैव प्रकारेण वारचयकृते सति ।
 विनिःसरेत् सर्वसत्त्वं संहिगु(?)गुरुषोदितम् ॥
 अथ सौराष्ट्रीगुणाः ।
 सौराष्ट्रदेशे सञ्जाता खनिजा^२ तुवरी मता ।
 या लेपिता श्वेतवस्त्रे रक्तवस्त्रकरी हि सा ॥

(1) The text reads वर्जितं, which seems to be incorrect.

(2) रसरत्नमुचय says ब्रह्मर्षि. See Chap. II. Verse 161.

(3) The text reads खनिजा, which is incorrect.

फुल्लिका खटिका¹ तद्वत् द्विप्रकारा प्रशस्यते ।
 किञ्चित् पीता च सुस्निग्धा गरदोषविनाशिनी ॥
 श्वेतवर्णा परा सास्त्रा फुल्लिका लोहमारणी ॥
 कषाया मधुरा काङ्क्षी कटुका विषनाशिनी ।
 वण्णो कफहा चैव नेत्रव्यापत्तिदोषहा ॥
 कण्ठरोगहरा सा तु पारदे वोजजारणी ।
 धान्यान्ने तुवरी चिक्षा शुध्यति त्रिदिनेन वै ॥
 जारैरास्त्रैश्च सृदिता धाता सत्त्वं विमुञ्चति ।
 तत् सत्त्वं धातुवादार्थं चौषधे नोपपद्यते ॥

यद्य पुटानि लिख्यन्ते ।

भूम्यां वै खन्यते गर्ते द्विहस्तं चतुरस्रकम् ।
 ह्रगणेन सहस्रेण पूरयेत्तदनन्तरम् ॥
 चौषधं धारयेन्मध्ये तदाच्छाद्य वनोपलैः ।
 सहस्राहोर्न वै सम्यग्वाङ्गं प्रज्वालयेत्ततः ॥
 महापुटमिदं प्रोक्तं सत्यकारेण निर्मितम् ॥

इति महापुटम् ॥

(1) रसरत्नसमुच्चय ३३५० कटकौ फुल्लिका.

एकहस्तप्रमाणं हि चतुरस्रं च गर्तकम् ।
 वनोपलसहस्रेण गर्तमध्यं च पूरितम् ॥
 मूषिकां चौषधेनाथ पूरितां तां तु मुद्रयेत् ।
 गर्तमध्ये निधायाथ गरिष्ठानि^१ च निक्षिपेत् ॥
 ऊर्द्धाग्निं ज्वालयेत् सम्यक् सोऽयं गजपुटो भवेत् ॥
 इति गजपुटः ॥

उपलं दिष्टकं क्वाणमुत्पलञ्च गरिष्ठकम् ।
 कृगणोपलसारी च तचरा^२ कृगणाभिधाः ॥
 अरन्निमात्रे कुण्डे च वाराहपुटमुच्यते^३ ॥
 इति वाराहपुटः ॥

वितस्त्रिद्वयमानेन गर्तं चेच्चतुरस्रकम्^४
 कुकुटाख्यं पुटं विद्यादौषधानाञ्च साधनम् ॥
 इति कुकुटपुटः ॥

(1) रहरवसमुच्चय reads निरिष्ठानि.

(2) रहरवसमुच्चय reads वराही.

(3) The text reads अरन्निमात्रेण कुण्डे च वाराहपुटमुच्यते,
 which seems to be incorrect.

(4) The text reads गर्तं कुक्काचतुरस्रकं, which marks the
 metre.

कृगणैरष्टभिः सम्यक् कपीतपुटमुच्यते ।

इति कपीतपुटः ॥

तुषैर्वा गोवरेर्वापि रसभस्मप्रसाधनम् ।

माणिकाद्यमानेन गोवरं पुटमुच्यते ॥

इति गोवरपुटः ॥

मृदभाण्डे तु प्रपूर्णेव मध्ये द्रव्यं तु विन्यसेत् ।

अधस्ताज्ज्वालयेदग्निं मृदभाण्डपुटमुच्यते ॥

इति (मृद)भाण्डपुटः ॥

गते तु बालुकापूर्णे मध्ये द्रव्यं तु विन्यसेत् ।

उपरिष्ठादधस्ताच्च वज्रं कुर्व्यात् प्रयत्नतः ।

तद्बालुकापुटं सम्यगुच्यते शास्त्रकोविदैः ॥

इति बालुकापुटः ॥

मूषिकां भूमिमध्ये तु स्थापितां द्यद्गुलादधः ।

उपरिष्ठात् पुटं दद्यात् तत् पुटं भूधराभिधम् ॥

इति भूधरापुटः ॥

(1) The text reads दद्या, which is incorrect.

गोवर्षैर्वा तुषैर्वापि मात्राकर्षमितैः पुटम् ।

यत्र तज्जावकाख्यं ख्यान्मृदुद्रव्यस्य साधने ॥

इति सावकापुटः ।

इति श्रीपञ्चनाभसूत्रश्रीयशोधरविरचिते

रसप्रकाशसुधाकरे दशमोऽध्यायः ।

अथातः संप्रवक्ष्यामि धातूनां कौतुकं परम् ।

स्नातुभूतं मया किञ्चित् श्रुतं यच्छास्त्रतः खलु ॥

तदहं कथयिष्यामि यत् कृत्वा ना सुखी भवेत् ॥

रसकं दरदं तार्क्ष्यं गगनं कुनटीसमम् ।

रक्तस्रुहीपयोभिश्च मर्द्दयेद्दिनसप्तकम् ॥

जलयन्त्रेण वै पार्श्वं चतुर्विंशतियामकम् ।

तेन वेधं द्रुतं तास्त्रं तारं वा नागमेव वा ॥

सह(गत)वेधौ तु तत्कल्पो जायते नात्र संशयः ॥

एकभागस्दाद्या सुतो वज्रवज्राय मर्द्दितः ।

खल्वे त्रिनिष्पाद्य रसे पञ्चभागसमन्विते ।

वेतयद्या च रागिण्या पीतकल्पं प्रजायते ॥

षोडशशेन दातव्यं द्रुते ताम्बे सुशोभने ।

जायते प्रवरं हेम शुद्धं वर्षचतुर्दशम् ॥

इति हेमक्रिया ॥

स्वर्णमाक्षिकं संख्येय काञ्चिके दिवसत्रयम् ।

चर्मरंग्य(गार)सेनेव मर्दयेद्दिनसप्तकम् ।

जलेन धीतं तावच्च यावद्धेमनिभं भवेत् ॥

दरदं रसदेयीयं गोमूत्रेणैव स्वेदयेत् ।

दोलायन्त्वेऽङ्गि^१ चत्वारि पञ्चाष्टुदशमो भवेत् ॥

मनःशिला पद्मनिभा रक्ता चैव सुशोभना ।

स्वेदिता सुनिपुण्यस्य रसेनैव तु दोलया ।

याममर्दमिता शुद्धा सर्वकार्येषु योजयेत् ॥

नवसारस्वत्या सूतः शोधितोऽग्निमति स्मले ।

सप्तभागानि सर्वाणि मर्दयेत्त्रिम्बकारसैः ॥

मातुलुङ्गरसेनैव कुमारीसुरसेन वा ।

सूर्यातपे विमर्दोऽसौ पाचितो जलयन्त्रके ।

दिनानि त्रीणि तैजान्नौ क्षुब्धोत्तदवतारयेत् ॥

(1) The text reads रसदेयीयो, which is incorrect.

(2) चङ्गि [चङ्गानि] is grammatically incorrect.

शतांशं वेधयेत्तारं शुद्धं हेमं प्रजायते ।
 जलभेदो यदा न स्वाभाव्यं कार्या विचारणा ॥
 शिलाया मारितं नामं कुमार्थ्याः स्वरसेन तु ।
 पुट्टादशयोगेन नागभस्म प्रजायते ॥
 शतसंख्यानि वै कुर्यात् पुट्टान्येवं शरावके ।
 कुमार्थ्याः स्वरसेनैव भावयेद्दिनसप्तकम् ॥
 पूर्व्ववत् पुट्टं कार्या यतसंख्यामितं तथा ।
 सूतगन्धशिलादद्भुतं चैन्नागभस्मकम् ।
 त्रिंशदनोपलैर्दद्यात् पुट्टं वाराहसंज्ञकम् ॥
 अनेन विधिना सम्यक् शतसंख्यानि दापयेत् ।
 पुट्टान्येवं कृते त्रीणि शतानि द्वादशाधिकम् ॥
 पञ्चादृढे काचमये कूपे द्वात्रिंशयामकम् ।
 बालुकाम्निं प्रदद्याच्च स्वाङ्गशैतं समुदरेत् ॥
 तलभस्मं यद्भौतस्य वेधयेत्तारशुद्धके ।
 शुद्धहेमं भवेत्तेन नात्र कार्या विचारणा ॥
 दृष्टप्रत्यययोगोऽयं कथितो नात्र संशयः ॥

Extracts from RASACHINTAMANI.

मदनान्तदेवसूरिविरचितात् रसचिन्तामणेः
उद्धृताः श्लोकाः ।

कैश्वर्यं तोरिकां सूतं कासीसं लकुचद्वयैः ।
विष्टुष्य खल्वभाण्डस्थं सर्वज्ञत्वं दिनत्रयम् ॥ ७५ ॥
हस्तिकायां तदारोप्य काष्ठवद्भिर्विधीयते ।
दिनत्रयैः प्यतिक्रान्ते भस्म ज्ञेततरं भवेत् ॥ ७७ ॥

* * * * *

इति त्रयोदश भस्मसूतः ।

खर्परी द्वादशांशः स्नात् शिखिशीर्षं च तुल्यकं ।
षड्गुणं माचिकं नेत्रभागं याज्ञं मनःशिला^१ ।
भागत्रयमिदं याज्ञं शोभनागतकर्करैः^२ ॥ ७८ ॥

(1) अपि नेत्रभागा मनःशिला is the correct reading as stated in the margin of the text.

(2) त्रयो भागा अपि याज्ञाः शोभना गतकर्करैः is the correct reading as stated in the margin of the text.

गंधकत्रयमेवास्ते काचमाचीरसैर्भृशं ।
 दिनसमात्र कर्त्तव्या भाङ्गना मर्हन् क्रमात् ॥ ३८ ॥
 अधोमुखेन यन्त्रेण तेन निःसारयेद्बुधः ।
 सत्त्वं तद्रसकस्याथ दृढं कार्य्यकरं परं ॥ ३९ ॥
 अवशं तद्दृढं सत्त्वं निर्धमं कर्मसाधनं ।
 इति रसकसत्त्वपातनं ।

द्विवारं गन्धकद्वयं ताम्रं हेमद्वयद्वयं ।
 सत्त्वं तालस्य मासैकं योजयेत् सर्वकामदं ॥ ४३ ॥
 यन्त्रवणे भवेद्धेमं ताम्रगंधकमारुतं ।
 एतयोर्दीयते रस्यं जायते कांचनं शुभं ॥ ४४ ॥

इति श्रीमदनांतदेवविरचिते रसचिंतामणौ
 हेमौकरणप्रयोगः ॥

पारदं सौमकं गंधं कुण्टो तच्चतुष्टयं ॥
 बीजपूरांभसा पिष्ट्वा बाह्यं दिनचतुष्टयं ॥ १०८ ॥
 अथ सूक्ष्माणि पञ्चाणि तेन तारस्य लेपयेत् ।
 बीजपूररसेनैतत् व्यतिमात्राग्नितापितं ॥ १०९ ॥

एकाधिका भवन्त्यत्र भावनायाश्च विंशति ।

विशोषावर्त्तितं तारं भवेत्तारस्य काचिनं ॥ ११० ॥

इति चिन्तामणी हेमौकरणप्रयोगः ॥

हेमभागद्वयं तारं तथा ताम्रं चतुष्टयं ।

एकतः क्रियते पञ्चमत्तिस्त्रुष्टं निरामयं ॥ १११ ॥

जंबीरनीरसं पिष्टं स्वर्परस्थाष्टकं ।

तेन ताम्रस्य पत्राणि लेपनीयानि वै बहु ॥ ११२ ॥

आवर्त्तते पुनर्दस्त्रा मूषके गलितानि च ।

तदा तानि भवन्त्यत्र हेमरूपाणि ताम्रया ॥ ११३ ॥

इति हेमौकरणप्रयोगः ॥

एकभागी भवेद्दारः तारं भागद्वयं भवेत् ।

वेदभागं भवेत्तीक्ष्णं सत्त्वं सत्त्वाच्च वै दय ।

वंगभागं भवेत्पत्रं सर्वमेकत्र कारयेत् ॥ १०८ ॥

टंकणेन पुनः धातं पत्रं कृत्वास्य वक्तुम् ।

वेलाचयमिदं धातं तत्क्रमधी निवेशयेत् ॥ ११० ॥

एवं तारं भवेन्नूनं परीक्षाक्रममापणे ॥

इति तारीत्यादिकं ॥

तुल्यकं पिबते खले त्रिफलाहिंशुटंकणैः ।

मध्वान्यमिश्रितं धातुं सत्त्वं पातयते भूवं ॥ ६८ ॥

इति तुल्यकसत्त्वपातनं ॥

खर्परः खेद्यते पूर्वं कौस्तुभेन जलेन च ।

वटारोहजलेनापि पर्णचूर्णेन शोभनः ॥ ७५ ॥

गुडटंकणसंमिश्रस्त्रिफलाकाशमर्दितः ।

सृज्यते कूपके कृत्वा धाम्यमानो भृशं च सः ॥ ७६ ॥

खेतधूमोद्गमि जाते तत उत्याद्य कूपकं ।

सावधानं करणैव भूमौ तं चाध चानयेत् ॥ ७७ ॥

पुनश्च धाम्यते कूपः तद्याजातं च तं पुनः ।

कूपकं च पुनर्भूमौ तथा तं नामयेत् पुनः ॥ ७८ ॥

सत्त्वं खर्परकस्यैतत् नागरूपं पतत्यधः ॥ ७९ ॥

इति खर्परसत्त्वपातनं ॥

Extracts from RASAKALPA.

रुद्रयामलान्तर्गतोत् रसकल्पादुद्धृताः
श्लोकाः ।

शिवं नत्वा रसाधोऽं चण्डिकाचरणं तथा ।
क्रियते^१ रसकल्पोऽयं रसज्ञानविशारदः^२ ॥ १ ॥

। अथ परीक्षा ।

अतेजा अगुरुः शुभ्रो लोहहा(ऽ)चक्षुलो रसः^३ ।
यदा^४ नावार्त्तयेद्वष्टौ नीहुं गच्छेत्तदा सृतः ॥ ४० ॥

(1) The text reads करोमि, which is grammatically incorrect.

(2) The reading in the text is विशारदम्, which is incorrect.

(3) The text reads रस, which is incorrect.

(4) The text reads यदाभावर्ययेत्, which is not correct.

दन्ते शृङ्गे मणी वेषी रजवेत् साधितं रसम् ॥ ४२ ॥

इति श्रीरुद्रयामले रससंकेतकं नाम
प्रथमोऽङ्काः ।

हेमरूप्याकं वङ्गाहि^१ लौहा लौहा^२ पट्टीरिताः ।

अक्षविमा इमे येषां वर्त्तायाः स्युस्तु^३ अविमाः ॥ १ ॥

सन्तो वङ्गाञ्जलिपुटो युष्मान् विश्रापयाम्यहम् ।

ऊपासुधारसयुता दृष्टिर्यस्ये प्रदीयताम् ।

महारसाः स्युस्तवादावष्टौ पारदहिङ्गुले ।

वैष्णवं शस्यकं शैलं चपलं रसकीऽमलम् ।

(महारसाः)

(1) The text reads वङ्गाहि, which is grammatically incorrect.

(2) लौहिर्लोहा is the reading of the text, which seems to be incorrect.

(3) The text reads रसार्तायासुद्धिमा, which is palpably an error.

अश्वकं तुल्यकं कान्तं रत्नावर्तमथाञ्जनम् ।

वज्रं वैक्रान्तकं चैव टङ्कणं च रसा बहु ॥

(रसाः)

गन्धकं तालकशिले क्षितिस्त्रेचरगैरिकाः ।

इत्यादयश्चोपरसाः सर्वाचार्यैरुदीरिताः ॥

(उपरसाः)

सितासितारुणं पीतं गन्धकं तच्चतुर्विधम् ॥

तालकं द्विप्रकारं स्यात् गोदन्तः पाटलच्छविः¹ ॥

रक्ता पीता शिला द्वेधा पूर्वा श्रेष्ठोत्तराधमा² ॥

बहुप्रकारा सौराष्ट्री कासीसं त्रिविधं मतम्³ ॥

कासीसं पुष्पकासीसं हीरकासीसमित्यथ ॥

गैरिको द्विविधः प्रोक्तः सौवर्णो लोहितस्तथा ॥

(1) The text reads षट्छवि, which seems to be incorrect.

(2) पूर्वा श्रेष्ठोत्तराधमा is the reading of the text, which is incorrect.

(3) The text reads कासीसत्रिविधं मतः, which is incorrect as it is mentioned nenter in the next line.

कङ्कुषादीन्¹ रसान् केचिदाचार्या वर्णयन्ति वै ।
 यस्माभिरिह तन्नोक्तं मुनिमार्गानुसारिभिः ॥

इत्येष प्रोदितो मार्गो रसगोधनकर्म्मणि ।
 स्वच्छन्दभैरवाद्युक्तो गोविन्दादिसमाहृतः² ॥

लवणं चूलिकोद्भूतं गन्धकेन समन्वितम् ।
 सर्वाङ्गदश्च³ चित्वाहं मूलमस्त्रप्रगालितम् ।
 गोमूत्रेण शतं भाष्यं तद्वसे जारयेत् शनौ⁴ ।
 तस्य संपर्कतः सूतो राजसो भवति ध्रुवम् ॥

(1) The text reads कङ्कुषादीन्, which is an error¹ of the scribe.

(2) The text reads यस्मादिह, which is incorrect.

(3) The text reads सर्वाङ्गदश्च, which seems to be incorrect.

(4) शनौ, as given in the text, is grammatically incorrect.

एतदेव विद्धं दद्यात् सर्वदा हेमजारणे^१ ।

मुखं संजायते तेन जोर्यते च^२ विनिश्चितम् ॥

इति श्रीरुद्रयामले रसकल्पे उग्रामहेखरसंवादे
रसशोधनप्रकारः ॥

इति संधानयोगोऽयं जारणेऽतिगुणावहः ॥

प्रकाशितः संप्रदायक्रमवातः शिबोदितः ॥

इति श्रीरुद्रयामले रसकल्पे उग्रामहेखरसंवादे
रसाधिकरणो^३ नाम द्वितीयोऽङ्कासः ॥

महारसानां सर्वेषां रसानां शुद्धिरुच्यते ।

तथैवोपरसानाञ्च शास्त्रदृष्टेन वर्त्मना ॥ १ ॥

कदलीपत्रजैर्नीरैः माक्षीकं भावयेत् शतम्^४ ।

तन्मध्वं तैलमध्वाज्य-पक्वमेकं दिनत्रयम् ॥

- (1) The text reads हेमजारणो, which is not correct.
- (2) The text reads न, which appears to be an error.
- (3) The text reads रसाधिकारेषा, which is incorrect.
- (4) The text reads मध्वं which is senseless.

तत्ताप्यं वज्रसूपायां¹ प्रकायां निक्षिपेत्ततः ।
 लोहसन्धानकरणं तत्समं तत्र निष्पचेत् ॥
 दृढां प्रकल्पयेन्मूषां² कोष्ठिके³ विनिवेशयेत् ।
 अङ्गारैः खदिरोद्भूतैः धमेद्भस्त्रादयेन वे ॥
 वक्त्रनालयुजा सत्त्वं ताप्यस्य पतति ध्रुवम् ।
 यत्कदीप्तिः सशब्दश्च⁴ यदा वैश्वानरो भवेत् ।
 तदा सत्त्वं तु पतितं जानीयात्तान्मथा क्वचित् ॥

रसकं स्वेदयेदादौ⁵ पटुचूर्णकृतं बुधः ।
 चतुर्गुणेन वस्त्रेण दृढं बध्ना च डोलिकाम् ॥

(1) तत्ताप्यं वज्रसूपायां is the reading of the text, which appears to be incorrect.

(2) The text प्रकल्पयेन्मूषां is evidently incorrect.

(3) कोष्ठिकानि निवेशयेत् is the reading of the text, which has no meaning at all.

(4) The text reads सशब्दश्च, which is 'grammatically incorrect.

(5) रसकंस्वेदयेदादौ is the reading of the text, which seems to be incorrect.

कृत्वा भाण्डे च सजले¹ स्वेदयेन्नासपञ्चकम् ।
 उद्धृत्य पञ्चादसकं खल्लमध्ये² विचूर्णयेत् ॥
 पादौघान् मालतीजातं सगुडं³ जीर्णगुञ्जकम् ॥
 गृहधूमं रेवकीं च निशामं कुल्लजीरकान्⁴ ॥
 तत् सर्वं चूर्णितं कृत्वा गोपचकविभावितम् ।
 कृत्वा तद्वटिकाः पञ्चात् छायायां शोषयेत्ततः ॥
 कोष्ठशैनाग्निना⁵ पञ्चादमेदुभस्त्रादयानिलैः ।
 सत्त्वं पतत्ससंदेहं स्थिररङ्गं दृढं बहु ॥
 एकमासं द्विमासं वा रसकं स्वेदितं यदि ।
 न घातयेत् तच्च कोष्ठे धमेत्तत् नालमूषया ॥

इति सम्पादितो मार्गो द्रुतीनां पातने स्फुटः ।
 साक्षादनुभवैर्दृष्टो न श्रुतो गुरुदर्शितः ॥

(1) कृत्वा भाण्डेन सजले .is the reading of the text, which is incorrect.

(2) The text reads खल्लमध्ये.

(3) The text has जीरका, which is grammatically incorrect.

(4) The text reads कोष्ठशैनाग्निना, which is not correct.

लोकानामुपकाराय एतत् सर्वं निवेदितम् ।
 सर्वेषां चैव लोहानां द्रावणं परिकीर्तितम् ॥
 इति श्रीरुद्रयामले रसकल्पे उमामहेश्वरसंवादे
 सर्वलोहद्रुतिपातनाधिकारः समाप्तः¹ ॥

Extracts from

RASARAJALAKSHMI.

विष्णुदेवविरचितायाः रसरजलक्ष्म्याः

प्रारम्भः—

यस्मैच्छाङ्कुरवल्ली मुकुलिता नानाकलाकीतुकेः
 चातुर्यैकविलोलपद्मवती कीर्तिप्रसूनप्रसूः ।

(1) समानं द्रवम् is the reading of the text, which is not correct.

संनिर्वापयति अवरत्रयमहो ऋष्याकलापैर्नृणां
सोऽयं पातु विचारमूर्तिरखिलं कालापलौढं जगत् ॥१॥

जयति दुरितसर्पस्तंभमंक्षोद्यदपः
प्रबलगदविनाशः सेविविधस्तनाशः ।
शिव इव विज(बीज ?)मंत्रः संहितायोगमंत्रः
त्रिपुरहरतनूजस्तेजसः कायपुंजः ॥ २ ॥

इति श्रीपण्डितमहादेवतनयश्रीविष्णुदेवविरचितायां
रसरत्नसङ्ग्रहासुक्तासः प्रथमः ॥

दृष्ट्वेमं रससागरं शिवकृतं श्रीकाकचण्डेश्वरो-
तत्त्वं सूतमहोदधिं रसमुधाब्धोधिं भवानौमतम् ।
व्याङ्गिं सुश्रुतस्त्वमीशहृदयं स्रच्छंदशक्तागमं
श्रीदामोदरवासुदेवभगवद्गोविन्दनागार्जुनान् ॥
प्रथमः उक्तासः ।

स्रच्छंदशक्तागमसारभूतः
समुद्धृतो विष्णुभिषग्वरेण ॥ ११० ॥
द्वितीयः उक्तासः ।

आलोक्ष्य सुवृत्तं इन्द्रहारीतचरकादिकान् ।

आत्रेयं बालभट्टं सिद्धसारं दामोदरं गुरुम् ॥

द्वितीयः सङ्काशः । *

* Foll. 1-¹³13. Linn. 10. Rasarājalakṣmī, de medicamentis metallorum et fossilium ope conficiendis liber, a Rāśīśvara (bhāṭṭa), Viṣṇus filio, compositus. Incipit : आनन्दैकरसं निखलकलनाभिमुक्तवीर्यात्मकं प्रायोजनविदग्धनि-
ष्पन्नम् etc. ॥ १ ॥ सविमुखीमंयनमंयनेन (1. कर्ममुखी) sphurad
Rasāmbhodhi-gabbhāragarbhat : s'ri-Viṣṇudevi (o devī)
labhate pr. tatnāt s'ri Viṣṇuvatsād Rasarājalakṣmīm
॥ 2 ॥ Dṛiṣṭvemaṃ Rasasāgaram, S'ivakṛitām s'ri-Karka-
chandes'varītantram, Sūtamahodadhim, Rasasudhām-
bhodhim, Bhavānmatam, Vyādi[m]. Susrūtasūtram,
lā'abridayam, Svachchhāndes'aktyāgampam, s'ri-Dāmoda-
ra-Vāsudeva-Bhagavad-Govinda-Nāgārjunān ॥ 3 ॥ आनन्द-
सारसंज्ञकं प्रसन्नं आनन्दकर्म निखलकलम् ।
वीर्योदसीकं भवरीमयेकं
जीमदगुहं निखलकं जसामि ॥ ४ ॥

सङ्काशः सुकलादावहो पारदर्शितुम् ।

वेद्यं सङ्काशं यत्नं चपलं रसकीमलम् ॥ ५ ॥

चमकं तुल्यं (tatthakam) कर्म राजावर्गमयाजनं ।

वयस्कैकान्तकं (o vaikrāntakam) सति टककं च रसानिद्रः ॥ ६ ॥

तामकं नखकमिलं चित्तिलेखरगैरिकाः ।

रम्यादयवीवरताः पूर्वाचारैरुदीरिताः ॥ ७ ॥

Aufrecht's "Catalogus," p. 321, No. 761.

Colophon at the end of the Rasarājalakshmi—

राजन् (सश)शार्ङ्गखिलराज्यदिवसे वारे हिमांशोरिदं
चंचद्भूतलपत्तने विजयिनि श्रीबुद्धपृथ्वीपतेः ।
शास्त्रं वैद्यकसाररूपमकरोत् श्रीविष्णुदेः कविः
वामदेवीचरणारविंदमकरंदामोदसौरस्येवैकम् ॥

Extracts from RASANAKSHATRAMALIKA

मथनसिंहविरचितायाः रसनक्षत्रमालिकायाः

उद्धृताः श्लोकाः ।

चतुश्चतुःशंखकपर्दिकानां
सतककस्त्रीरविमर्दितानाम् ।
आफेनमाक्षीकविषहयानां
पलं पलं दन्तिफलाश्वितानाम् ॥ २५ ॥

यतभस्मगन्धसूता हितयं बहुस्य शुद्धतीक्ष्णम् ।
 दग्ध्वा मृगस्य शृङ्गं त्रिगुणं दत्त्वा रसार्धविषम् ॥ १२१ ॥
 चिचकशोतशिवावृषदशमूलदिवनदविष्वगिरैः ।
 कलहत्तारविकृतकैः प्रत्येकं भावनञ्जितयम् ॥ १२४ ॥
 दत्त्वा सुसिद्धमात्रो मारिचधूपेन धूपितः सम्यक् ।
 स्वच्छन्दभैरवाख्यो रसः समस्तामयध्वंसी ॥ १२५ ॥
 चिकटुकरसेन युक्तो विधेयतः सन्निपातहरः ।
 बह्विगदामयशूलजघविद्रधिवातगुल्मजयी ॥ १२६ ॥
 इति स्वच्छन्दभैरवो रसः ॥*

इयं मालविभूषालभिषजा भिषजा मता ।
 कृता मधनसिंहेन रसनक्षत्रमालिका ॥ १४२ ॥

इति रसनक्षत्रमालिका समाप्ता ॥ अस्ति

संवत् १५५७ चार्श्विन कृष्ण ५ सोमि ।

* The स्वच्छन्दभैरव रस mentioned in the रसनक्षत्र-मालिका is quite distinct from that, which is stated in the रसैन्द्रचिन्तामणि. Neither has it any analogy with what is described in the रसरत्नसमुच्चय.

Extracts from RASARATNAKAR

नित्यनाथविरचितात् रसरत्नाकरात्

उद्धृताः श्लोकाः ।

यदुक्तं शम्भुना पूर्वं रसखण्डे रसार्णवे ।
रसस्य वन्दनार्थं च दीपिकारसमङ्गले ॥
व्याधितानां हितार्थाय प्रोक्तं नामार्जुनेन यत् ।
उक्तं चर्पटिसिन्धेन' स्वर्गवैद्यकपालिके ।
अनेकरसशास्त्रेषु संहितास्वागमेषु च ।
यदुक्तं वामटे तन्त्रे सुश्रुते वैद्यसागरे ॥
अन्वेष्य बहुभिः सिद्धैः यदुक्तञ्च विलोक्य तत् ।
तत्र यद्यदसाध्यं स्थादयद्यदुत्कर्षममीषधम् ॥
तत्तत् सर्वं परित्यज्य सारभूतं समुद्धृतम् ॥
लक्षिष्वास्ते क्रिया नास्ति कमथापि न च कश्चित् ।

(1) चर्पटिसिन्धेन is the reading in the Sanskrit college MS.

मात्रायुक्तिः कचिन्नास्ति सम्प्रदायो न च कचित् ।
 तेन सिद्धिर्न तत्रास्ति रसे वाय रसायने ॥
 वैद्ये वादे प्रयोगे च तस्मादयन्नो मया कृतः ।
 यद्यदयुक्तमुखाज्ञातं खानुभूतञ्च यन्मया ।
 तत्तन्नोक्तद्वितीयं प्रकटीक्रियतेऽधुना ॥

प्रथमोपदेशे ।

इति श्रीपार्वतीपुत्रनित्यनाथसिद्धविरचिते रसरत्नाकरे
 रसखण्डे रसपौठिका नाम प्रथमोपदेशः ।

परीक्षा मारिते सुते कर्तव्या च यथोदिता ।
 अधस्तुषाम्निना तप्तो ह्यसौणस्तिष्ठते यदा ।
 तदा भस्म विजानीयाच्चुल्लायां यामं निरीक्षयेत् ॥
 तृतीयोपदेशे ।

दत्ते मृक्केऽथवा वंशे रक्षयेत् साधितं रसम् ।
 चतुर्थोपदेशे ।

अथातः शुद्धसूतस्य मूर्च्छनाविधिश्चरति ।
 मेघनादावचाहिङ्गुशूरणैर्मर्ह्यैर्द्रवम् ॥

नष्टपिष्टस्तु तद्गोलं चिह्ना वेष्टयेद्वहिः ।
 पचेन्नवणयन्त्रस्यं दिनैकं चण्डवह्निना ॥
 ऊर्ध्वलम्बं समादाय दृढं वस्त्रेण बन्धयेत् ।
 ऊर्ध्वधो गन्धकं तुल्यं दत्त्वा सोमानले पचेत् ।
 जीर्णं गन्धे पुनर्दयं षड्भिर्वारेः समं समम् ।
 षड्गुणे गन्धके जीर्णे मूर्च्छितो रोगहा भवेत् ॥
 चतुर्धापदेशे ।

Extracts from
DHATURATNAMALA.

धातुरत्नमालायाः

प्रारम्भः—

प्रणम्य वितर्तौ शक्तिं विसृज्युत्पत्तिकारिणीं ।
 धातूनां रत्नमालायामभिधायं करोम्यहं ॥ १ ॥
 ब्रह्मविष्णुहराद्यान् ये मर्त्ता ध्यायन्ति नित्यशः ।
 ज्ञानदानप्रदानाय सा मे विश्वेश्वरी मता ॥ २ ॥

अथ धातूनां रत्नमालां वक्ष्यामि ।

रौप्यं हेमं तथा ताम्रं नागं वंगं तथायसं ।

खर्पराभ्रकमौक्तं च प्रवालं तालकं शिला ॥ ३ ॥

सुवर्णमाक्षिकं सूतं हीरकं च ब्रवीम्यहं ।

सर्वधातूपधातूनां लक्षणं मारणं गुणं ॥ ४ ॥

अथ रौप्यमारणं ।

रौप्यं शुद्धं समादाय नागेन गुरु शोधयेत् ।

शुद्धे तारे पुनः पश्चात् सूक्ष्मपत्राणि कारयेत् ॥ ५ ॥

निबर्चिचिणिद्राक्षाभिः शोधयेच्च पृथक् पृथक् ।

क्षालयेद्दुदकैः साहं तथा दुग्धेन शोधयेत् ॥ ६ ॥

गंधपारदयोरेकं किञ्चिद्द्वयं च चर्षयेत् ।

द्राक्षाया द्रवसंयुक्तं तारपत्राणि शोधयेत् ॥ ७ ॥

चक्रयन्त्रे विनिक्षिप्य क्षेपयेद्वस्त्रसत्तिकां ।

क्षिपेद्गजपुटे गर्ते ज्वालयेद्बहुक्कानकान् ॥ ८ ॥

समाप्ति :—

संघो वैद्यकनामायं रससिद्धांतसामरात् ।

धातूनां रत्नमाला च ततो वैद्यस्य देतवे ॥ १०६ ॥

मरुषेभ्यो भयन्नस्ता रोगप्रस्ताश्च ये नराः ।

रत्नमाला कृता तेषां वैद्यानां च हिताय वै ॥ १७७ ॥

इति श्रीवैद्यकशास्त्रे अश्विनीकुमारसंहितायां

धातुरत्नमालायां समाप्तीऽयं ग्रन्थः ॥

The following is taken from Aufrecht's
"Catalogus"—No. 760.

Incipit :—प्रणम्य सारदां शक्तिं सृष्टेरुत्पत्ति-
कारकां । धातूनां रत्नमालां च विबोधाय करोम्यहं
॥ १ ॥ ब्रह्माविष्णुहरान् ध्यायेद्ब्रह्मा ध्यायन्ति निखणः ।
तेषां वरप्रदानाय सा मयैवमुदीर्यते ॥ २ ॥ रूप्यं
हेम तथा ताम्रं नागं वंशं तथायसं । खर्परं गगनं
प्रोक्तं प्रवालं तालकं शिला ॥ ३ ॥ माचिकं गंधकं
सूतं हीरकं च ब्रवीम्यहं । सर्वधातूपधातूनां लक्षणं
सारणं गणान् ॥ ४ ॥ रूप्यं शुद्धं समानीय नाग-
मूषा नु शोधयेत् । शुद्धे तारि पुनः पश्चात् सुवस्त्र-
पत्राणि कारयेत् ॥ ५ ॥ निंबुचिचिणीद्राक्षाभिः शोधनीयं
पृथक् पृथक् । जालयेद्दुदकैः साहं तथा दुग्धेन
शोधयेत् ॥ ६ ॥ गंधकं पारदं रूप्यं किंचिद्वंशं च

वर्षयेत् । द्वाचारसेन संयुक्तं तारपत्राणि लेपयेत्
॥ ७ ॥ नक्तं यन्त्रे विनिरूप्य लेपयेद्वस्त्रसूक्तिकां ।
सेष्यं गजपुटे गते ज्वालयेच्च यक्षीपलेः ॥ ८ ॥

In fine libelli disticha haec leguntur :
ग्रंथो वैद्य [क] नामायं Rasasiddhāntasāgarāt ।

धातूनां रत्नमाला च कृता वैद्यसुहेतवे ॥ १ ॥

मरुषेभ्यो मयवस्ता रोगघस्ताश्च ये नराः ।

रत्नमाला हि धातूनां कृता तेषां हिताय वै ॥ २ ॥

Jātyā Gurjarakhandas cha, Devadatto

hi dharmavit ।

Harer nāmābbhidhānasya सुतस्तास्य भिषग्वरः ॥ ३ ॥

संहितारसकर्माणि यस्य बुद्धिर्गरीयसी ।

तेन शास्त्रविधिज्ञेन कृता रत्नस्य मालिका ॥ ४ ॥

इति देवदत्तकृतवैद्यकशास्त्रे धातुरत्नमाला ॥

Extracts from RASAPRADIPA.

रसप्रदीपादुद्धृताः श्लोकाः ।

A—MS. from Alahabad.

B—MS. from Benares.

अथ शङ्खद्रावरसः ।

स्फटिका¹ नवसारस्य सुधेता² च सुवर्चिका ।
पृथक् दशपलोत्मानं गन्धकः पिचुसंसितः³ ॥
चूर्णयित्वा क्षिपेद्वाण्डे मृन्मये सुदुर्विलेपिते⁴ ।
तन्मुखं सुद्वयेत् सम्यक् सुदुभाण्डेनापरेण च ॥
सरन्धोदरकेणैव चक्ष्मां तिथ्येक् च धारयेत् ।
अधः प्रज्वालयेदङ्गिं हठादयावद्रसः सवेत् ॥

(1) A reads स्फटिका, B. reads स्फुटिका.

(2) B reads सुधेता, which is not correct.

(3) B reads पिचुसंसितः, which is not correct.

(4) मृधं लेपिते is the reading in B.

ग्राणेकं सेवयेदयक्षात्¹ दत्तस्यैविवर्जितम् ।
 गुल्मीदरयक्तत्प्रीहयन्वियक्षादिशूलनुत् ।
 बलपुष्टिपदी ह्येष भुक्तं च जारयेत् क्षणात् ।
 विलोक्यतां महालोका रसमाहात्म्यमद्भुतम् ।
 कपर्दकाय लोहानां यस्मिन् चित्ता² गलन्ति हि ॥

फिरङ्गव्याधिः—

गैरिकं रसकर्पूरम् उपला च पृथक् पृथक् ।
 टङ्कमात्रं विनिष्पिष्य³ ताम्बूलौदलजैः रसैः ॥
 वयस्यतुर्दशास्तेषां⁴ कर्तव्या भिषगुत्तमैः⁵ ।
 सायं प्रातः समश्नीयात्⁶ एकैकां दिनसप्तकम्⁷ ॥

- (1) B reads यक्षु.
- (2) A reads चित्ता.
- (3) A reads विनिष्पिष्य.
- (4) A reads चतुर्दशैकोषा. B reads चतुर्दशकोषा.
- (5) B reads भिषगौत्तमौ, which is incorrect.
- (6) B reads समशौयान्, which is incorrect.
- (7) दिनसप्तकं an incorrect variant in B.

सष्टता योल्लिका^१ देया भोजनाद्यै निरन्तरम् ।
फिरङ्गव्याधिनाशाय वटिकेयमनुत्तमा ॥ *

(1) जीधूमरीटिका प्रत्यर्थः.

* The following is taken from योगतरङ्गिणी of Tri-mallabhatta, printed in Bombay in the S'aka year 1810.

यन्मे सुनिहो जमदग्निसाख्ये
निधाय सुतस्य पञ्चानि पंच ।
वल्कीकृत्य स्यात्कटिकेष्टिकायां
सर्गैरिक्तानां तुलसीपुतानाम् ॥ ६० ॥
सर्पैश्चवानां समसागिकानां
चूषादिकं शोषरिगो निदध्यात् ।
अस्मेन दत्ता सङ्घिषीभवेन
पिष्टं रसीनस्य शरावसेकम् ॥ ६१ ॥
समकृमिषाव निधाय खल्वे-
राच्छादयेत् खर्परजैर्विसेधि ।
धूर्ध्ववलिप्रोदरमूर्ध्वभाकं
सेव्यान्व संसुद्रा दृढं सुचुष्टम् ॥ ६२ ॥
प्रज्वालयेद्विक्रिमधः क्रमेण
संस्त्राव्य शोषपरि वस्त्रमाद्रेत् ।
वटिं प्रदद्याद्दिनचट्थमव
सत् स्वाङ्गमीलं परिगृह्य कुक्ष्या ॥ ६३ ॥

चन्द्रोदयाख्य रसवर्णने—

काशे खासे फिरङ्गाख्ये रोगे च परमो हितः ।

अथ उपायान्तरम्—

मुशखा¹ कुलङ्कशैव² पारसौक्यमानिका ।

भङ्गातकफलं चापि पलमानं पृथक् पृथक् ।

तं द्रोणमुच्योपयसा प्रविष्टं

कुण्यां विदध्यान्नवसादरं च ।

कर्पूरमात्रं प्रचरन्त्यं च

वज्रं प्रदद्यादथ शीतलागौम् ॥ ६४ ॥

निष्कास्य कृपौ सिकताख्ययसा-

दास्यीत्य कतकममुं प्रगच्छात् ।

कर्पूरनामा रसनायकोऽथ

वज्रः पुराणेषु गुडेन भुजः ॥ ६५ ॥

निर्वातिभाजाः सुखजा च पथ्य-

शौकेन कुठामयमाशनः स्यात् ॥

फिरङ्गकपिकेशरी सकलकुष्ठकालानली-

ऽखिलरूपविनाशकदहधनकर्षोपनिषदः ।

सुवर्णसमवर्ण इत्युक्तमन्तेनैकैरः

समस्तदन्तस्करी रसपतिः स कर्पूरकः ॥ ६६ ॥

इति कर्पूररसः षोडशसंज्ञात् ।

(1) B reads सुशङ्गा.

(2) B reads कलकं चैव.

पलाईमानः सूतः स्यात् षट्पलोऽत्र गुडः स्मृतः ।
 एकीकृत्याखिलं कुर्यात् वटीः कर्षमाणतः ॥
 खादेदेकां वटीं प्रातर्यावदारोग्यदर्शनम् ।
 गोदध्नद्यानुपानेन फिरङ्गामयनाशिनौ⁽¹⁾ ॥
 निम्बुकेन⁽²⁾ विना नैव वर्जनैयमिहापरम् ॥

अथ उपायान्तरम्—

चोपचीनीभवं चूषे शाणमानं समाल्लिकम् ॥
 फिरङ्गव्याधिनाशाय भक्षयेत्तत्र त्वजित् ॥

(1) B reads फिरङ्गापविनाशिनौ.

(2) B reads निम्बुकेन.

Extracts from DHATUKRIYA or DHATUMANJARI.

रुद्रयामले धातुक्रिया धातुमञ्जरी वा । *

योगणेशाय नमः ।

पाञ्चसुवाच ।

अथानन्तरं^१ देवेश ब्रूहि धातुसंस्कृतिम् ।

येन विज्ञानमात्रेण साधयेद्भातुसंज्ञितः ॥ १ ॥

महादेव उवाच ।

धातुस्तुर्यविधः प्रोक्तः तुर्यस्तुर्यं स्वपञ्चतः (१)^२ ।

सत्त्वं रजस्तमश्चैव चतुर्थस्तु निरामयः ॥ २ ॥

* The Ulwar MS. (A) reads धातुक्रिया, a part of the 'Rudrayāmala'; but the Benares MS. (B) reads धातुमञ्जरी, a part of the same. The two MSS. are exactly the same in subject matter, differing only in name.

(1) A reads अथानन्तरं, which is grammatically incorrect.

(2) A reads धातुसंस्कृति, which is grossly incorrect.

(3) The sense here is not clear.

राजसे राजसी सिद्धिस्तामसे तामसी मुदा ।

सत्त्वसाधनं सात्त्विके भवतीति^१ सर्वसाधनम् ॥ ३ ॥

पाब्बैतुवाच ।

कथ्यतां देवदेवेश सत्त्वं राजसतामसम् ।

भृतीव गुणवत्^२ धातोः कार्यं लक्षणलक्षितम्^३ ॥ ४ ॥

उपधातुक्रमेणैव तेषां लक्षणसाधनम् ।

विटकी च मुदा युक्ता तेषां कर्मसु^४ साधनम् ॥ ५ ॥

उपकारी^५ गुणलक्षं नाना कार्यक्रिया शुभा ।

विद्योगयोगचाञ्चल्यं वर्णमेदेसु मारणम् ॥ ६ ॥

समग्रं देवदेवेश विशेषा धातुलक्षक्रियाः ।

येन विज्ञानमात्रेण साधयेत् गन्धकीः क्रियाः ॥ ७ ॥

(1) A reads भवतीति, which seems to be incorrect.

(2) A has गुणवती, which appears to be incorrect.

(3) कार्यं लक्षणलक्षितम्, a variant in A, which is not correct.

(4) A reads erroneously कर्मसु

(5) A reads उपकारं, which is grammatically incorrect.

महादेव उवाच ।

पृथिव्या गर्भमध्ये तु षनेका धातुस्तिष्ठति^१ ।

विस्तृता^२ कथत्कालेन धातुर्नानाविधोदिता^३ ॥ ८ ॥

गुणलक्षणसंयुक्ता^४ साम्प्रतं न स्मरामि ह^५ ।

कथं ते कथयिष्यामि^६ वद ब्रह्माण्डवासिनि ॥ ९ ॥

पाञ्चत्युवाच ।

ये केचित् स्मरन्त्यन्त^७ ईय व्यक्तं कथय साम्प्रतम् ।

भवतो^८ऽनुपहृषेयैव साधनार्थं^९ सिध्यति ॥ १० ॥

(1) षनेका धातु तिष्ठति, a variant in A, which treats the word धातु in the neuter as well as in the feminine genders.

(2) A reads विस्तृता, which is not correct.

(3) धातुर्नानाविधोदिता, an incorrect variant in A.

(4) A reads संयुक्ता, which is grammatically incorrect.

(5) A reads स्मरति ह, which is incorrect.

(6) कथयामास is the incorrect reading in A.

(7) A and B read स्मरते, which is grammatically incorrect.

(8) स्मरतः is the reading in A and B, which is not correct.

(9) साधनार्थं is the incorrect reading in A and B.

महादेव उवाच ।

शृणु देवि प्रवक्ष्यामि धातुं नानाविधस्थितिम् ।

गुणलक्षणसंयुक्तां यथा बुद्धिः^१ कथिष्यति ॥ ११ ॥

मुख्यप्राधान्यता^२ एते रङ्गलोहक^३ताम्रकैः ।

रजतेनैव^४ संयुक्ता धातोरुत्तमता सदा ॥ १२ ॥

मध्यमा सखजा धातुः^५ नीचा च त्रयुसीसयोः ।

संयोगे धातुनामा हि नीचा नीचतरा श्रुता ॥ १३ ॥

संयोगान्ते त्रिधा प्रोक्ता उत्तमा मध्यमाधमा ।

ताम्रजासखयोर्योगि^६ नारीधातुः प्रजायते ॥ १४ ॥

(1) A and B read बुद्धिः

(2) मुख्यप्राधान्यता is the correct reading. प्राधान्यता is grammatically incorrect.

(3) A and B have रङ्गलोहक^३ताम्रकैः, which mars the metre.

(4) A reads रजतेनैव, which is not correct.

(5) धातुः is used here in the feminine gender both by A and B.

(6) Vide verse 20.

एषा^१ मध्योत्तमा प्रोक्ता कार्यकारणयोगके ।
 चपुतास्त्रसंयोगेन^२ जाता धातुष मध्यमा ॥ १५ ॥
 सौप्तिके^३ भङ्गदा प्रोक्ता कार्यकाले सदोदिता ।
 अनेनैव प्रकारेण येन येन च कर्मसु ॥ १६ ॥
 कर्त्तव्या जायते विद्या ज्ञात्वा^४ बुद्धिविशारदः ।
 अभङ्गं सौप्तिके जातं शुद्ध उत्पत्त्यकारकम् ॥ १७ ॥
 द्वाटके ज्येष्ठता जाते^५ अक्षया^६ रजते यदि ।
 लघुद्राघः शुभे शुक्ले लोहे च द्वात्रिंशो कला ॥ १८ ॥

(1) Both A and B read एतन्, which is grammatically incorrect.

(2) संयोगे is the reading in A and B, which mars the metre.

(3) A and B reads औप्तिके.

(4) A reads ज्ञात्वा, which is incorrect.

(5) A and B read जाते, which is incorrect.

(6) A reads अक्षयो. B reads अक्षयी. Both the readings seem to be incorrect.

जामले चङ्कहीना च काठिन्याभ्यधिकौ परौ ।
 कला एतास्य धातूनां जातेभवति शुद्धता^१ ॥ १८ ॥
 कला एतादृशी दिव्याः प्राप्तः^२ सिद्धस्तु जायते ।
 मुख्यजामत्वसंयोगे नारीधातुस्तु^३ जायते ॥ २० ॥
 कार्यनिककरी प्रोक्ता पात्रामोदस्तु^४ कोमला ।
 मारणे जारणे दिव्या चारणे लोटने तथा ॥ २१ ॥
 निर्गन्धा वर्णरहिता जातिभेदकरी स्मृता^५ ।
 एतावद्^६ गुणसंयुक्ता कार्यकारणसंयुता ॥ २२ ॥

(1) जाते भवति शुद्धता, a variant in A. जाते भवति रशुद्धता, an incorrect variant in B.

(2) A and B read प्राप्ते, which is grammatically incorrect.

(3) A reads नारीधमत्वस्तु. B reads नारीधमत्वस्तु. Both seem to be incorrect. (Vide verse 14.)

(4) B reads पात्रामोदस्तु, which is unintelligible.

(5) A reads मता.

(6) Both A and B read एतद्, which destroys the metre.

संस्कारेः संस्कृता सर्वेः^१ सर्वसिद्धिकरी स्मृता ।
 नानासुवर्णकार्येषु रूप्यकार्येषु संयुता ॥ २२ ॥
 धातुर्धाता च या^२ धातुः सुधामायःसुसंस्कृता ।
 कार्यसिद्धिकरी^३ श्रेष्ठा ज्येष्ठकार्यविधायिका^४ ॥ २४ ॥
 सर्वथा शु सुधामायः^५ आससद्वर्णसादकः (१) ।
 आहवेत् आसमातेष पाचयेदशन^६ स्त्रियम् ॥ २५ ॥
 स्वकीयाशनसंयुक्ते^७ जाते भवति सिद्धिदा ।
 अन्यथा नैव सिध्यन्ति जायते मृग-सम्बवत् ॥ २६ ॥

(1) A and B want सर्वे, thus rendering the foot incomplete.

(2) A and B read ये, which is not correct.

(3) कार्यसिद्धिकरी is the variant in A and B.

(4) A and B read विधायिका, which is grammatically incorrect.

(5) A has an incomplete foot सर्वसिद्धिदा. B also has सर्वसिद्धिदा.

(6) A reads पाचयेत् अन्न. B reads पाचयेत् अन्न. Both of them seem to be incorrect.

(7) B reads संयुक्ते.

तस्मात्तेनैव यत्नेन सुधामायः¹सुसंस्कृतिः ।

यद्योक्तसंस्कृतियुता² सर्व्वतो धातुरुत्तमा³ ॥ २७ ॥

क्रियोचितसुसंस्कारान्⁴ कारयेद्यत्नतः सदा ।

यद्योदितैस्तु संस्कारैर्युक्ता कार्य्यकरो सदा ॥ २८ ॥

सर्व्वलक्षणसंयुक्ता धातुधीता सदैव हि ।

जायते नैव सन्देहः कार्य्यकारणकारिका⁵ ॥ २९ ॥

पाठ्यत्वाच्च ।

क्रियत्परिमिता धातुः संख्या वदतु मे विभी ।

उत्पत्तिर्लक्षणं तेषां स्थानं चैव⁶ पृथक् पृथक् ॥ ३० ॥

(1) A reads सुधासाय, B reads सुधासाय. Both are unintelligible.

(2) Both A and B read संयुक्ता, which mars the metre.

(3) सर्व्वे ते धातुरुत्तमाः, a variant in A and B, which is grammatically incorrect.

(4) A and B read only संस्कारा, which is incorrect.

(5) Both A and B read कारयतः, which seems to be incorrect.

(6) B reads स्थानं तेषां.

कथ्यतां देवदेवेश लक्ष्यलक्षणसंस्कृतिः ।

भेदोऽभेदोऽथ^१ योयस्य मारणं चारणं तथा ॥ ३१ ॥

पातनं द्रावणं चैव त्रोटनं जारणं तथा ।

सारणं जीवनं षण्डं गोपनं लेपनं पुनः^२ ॥ ३२ ॥

जातिभेदः सुगन्धस्य मेलनं जरणं परम् ।

समग्रं कथ्यतां देव उपधातुकरी क्रिया ॥ ३३ ॥

महादेव उवाच ।

शृणु देवि प्रवक्ष्यामि धातुस्त्रानानि लक्षणम् ।

उपधातुरनेका हि^३ तेषां मारणचारणम् ॥ ३४ ॥

अस्य^४ राग(?)कारं च शोधनं बन्धनं तथा ।

मारणादि च यत् प्रोक्तं तत् सव्यं श्रूयतां शुभे^५ ॥ ३५ ॥

(1) भेदाभेदाथ is the incorrect reading in A and B.

(2) A reads पुनः, which is senseless.

(3) उपधातुरनेकानि, an incorrect variant in A and B.

(4) Both A and B want this word, which may be supposed to be राग or बन्ध here.

(5) तत् सव्यं कथयामि ते, a variant in A.

पार्श्वेऽस्यवाच ।

प्रथमं वद देवेश धात्वनुक्रमलक्षणम् ।

प्रत्येकस्थानरूपं हि गुणसम्बन्धकारकम् ॥ १६ ॥

महादेव उवाच ।

शृणु देवि प्रयत्नेन सिद्धान्तवचनं मम ।

यत्र विज्ञानमात्रेण जायते धातुकृतक्रिया ॥ १७ ॥

प्रथमे धातुनामानि संचेपात् काव्यकारणम् ।

कथयामि च ते भट्टे पश्चात् स्थानस्य संपदः⁽¹⁾ ॥ १८ ॥

आदौ सुवर्णनामानि संचेपात् शृणुतां प्रिये ।

स्वर्णं सुवर्णं सूर्यस्य चाटकं वज्रिरोचनम् ॥ १९ ॥

सु(स) रङ्गं च तथा लोहं देवधातुर्मनोहरम् ।

वेशी⁽²⁾ विष्णासगं चैव धर्म्यं कृषिदेवता ॥ ४० ॥

जीवनम् अमृतं चैव हिमं⁽³⁾ हिमवतोद्भवम्⁽⁴⁾ ।

देववक्त्रभगं दिव्यं संसारोत्तारणं महत् ॥ ४१ ॥

(1) Both A and B read संपदि, which has no sense.

(2) A reads वशी.

(3) हिम is generally used

(4) हिमवदुद्भव is the correct term.

जीवनं सर्वलोकानां¹ नारीणां रश्चनं शुभम् ।
 अन्यानि विविधानामानि² गोप्यगोप्यतराणि च³ ॥ ४२ ॥
 रजतं च तथा रूप्यं चन्द्रसुन्दर्य दीपकम् ।
 शुभ्र ज्योतिःकरं⁴ स्वर्णेषद्वीजं तारकं तथा ॥ ४३ ॥
 अनन्ता वर्तते तेषां कथा हृदिकराद्य ये ।
 स्थापितं लौकिकं चेदं⁵ येनाश्रयसमूहनम् ॥ ४४ ॥
 शीतवीर्यं क्षुब्धवीर्यं विषघ्नं वातनाशनम् ।
 रसपुष्पीकरं शौदं धातुपुष्पनकारकम् ॥ ४५ ॥

(1) The first term in the previous verse is only जीवनं. But here it is सर्वलोकजीवनं. Hence there is no repetition.

(2) अन्यानि विविधानामानि, an incorrect variant in A and B.

(3) गोप्यगोप्यतराणि च is the reading in A and B, which has no clear sense.

(4) A and B read शुभ्रवीर्यकरं, which is incorrect.

(5) A reads लौकिका येना, which leaves out चेदं.

रतिदं बहुवीर्यं च शुभधाम च मञ्जयम् ।
 एतानि रत्ननामानि शतान्यन्यानि सन्ति वै ॥४६॥
 ताम्रं च^१ ल्यूम्काधिष्ठं शुक्लं नागस्य मर्द्दनम् ।
 नीलं च नीलविभ्रमं वसनं^२ चैव पातकम् ॥ ४७ ॥
 उष्णम् उष्णकरं सिद्धं कृकशं कालमर्द्दनम् ।
 हेमगर्भं^३ च कामोदं विषदं विषनाशनम् ॥ ४८ ॥
 आरक्तस्य सहायस्य^४ मन्मथो मार एव च ।
 एतानि शुक्लनामानि अन्यानि विविधानि च ॥४९॥
 जास्रत्वं च जरातीर्तं राजतं यशदायकम् ।
 रुप्यभ्राता वरीयस्य खोटकं कोमलं लघु ॥ ५० ॥

(1) A has शतान्यानि वर्तते. B has शतानानि वर्तते, Both the readings are grammatically incorrect.

(2) च is dropped in A and B.

(3) The sense of नीलविभ्रमं seems to be नीलविभ्रमं = नीलवीभम्. A reads वसनं, which is incorrect.

(4) A reads हेमगर्भे.

(5) A and B read सहस्रदं च.

चर्मकं खर्परं चैव रसकं रसवर्द्धकम् ।
 सदाप्यं वलीपितं पीतरागं सुभक्षकम् ॥ ५१ ॥
 एतत्तु खर्परनाम कार्यकर्मसु सिद्धिदम् ।
 रसराजार्द्धकं कर्म कृतं सिद्धिषु जायते ॥ ५२ ॥
 तपुस्तापहरं वङ्गं रजतारिखं नीरदम् ।
 गीतवीर्यकरं श्रौतं रतिदं तापहारकम् ॥ ५३ ॥

(1) रसवर्द्धक, the reading in A and B, is not grammatically correct.

(2) तमे is the reading in A and B; which is incorrect.

(3) Both A and B read कार्यकर्मसु सिद्धिदान्, which is grammatically incorrect.

(4) रसराजार्द्धकान् कर्मसु, an incorrect variant in A and B.

(5) A reads कृते सिद्धिषु. B reads कृते सिद्धिषु. Both are incorrect.

(6) Both A and B read रजतानि च, which is senseless here.

मेघन्नं माहसाद(?)भूतं सहायं धातुशेषयोः ।
 एतानि त्र्युनामानि सुसिद्धं कार्यकारकम् ॥ ५४ ॥
 सौमिकं^१ धातुभङ्गं च सृतकं रोचकं परम् ।
 रक्तं च रक्तवीर्यं च^२ रक्तवस्तुविवर्धनम् ॥ ५५ ॥
 अम्लरूप्यं च गन्धीरं धातुभस्वनकारकम् ।
 यावत् रसरत्नेन अक्षोभ्याक्षोभणं परम् ॥ ५६ ॥
 विचित्रं विनतं चैव नानारङ्गप्रदायकम् ।
 नामं नमालयं प्रोक्तं सिद्धकं कण्ठशीघ्रनम् ॥ ५७ ॥
 पण्डं पण्डकरं^३ चैव दुरितं पण्डकारकम् ।
 एतानि^४ नामानामानि कार्यकाले प्रयोजयेत् ॥ ५८ ॥
 लोहं च आयसं शूरं सूर्यकर्मविशारदम् ।
 हस्तकं खननं खर्णमारकं^५ ताटकं मलम् ॥ ५९ ॥

(1) सुसिद्धे कार्यकारकान्, an incorrect variant in A and B.

(2) A and B read सौमिकं.

(3) B has only रक्तं वीर्यं च, which is incomplete.

(4) A reads खड्गं खड्गकरं चैव.

(5) A and B read एतानि, which is incorrect.

(6) A has लये शारकं. B has खर्णे शारकं.

अजरं च जरायुर्द्ध धात्वाद्यम् अवनोसुतम् ।
 कालेयं जीर्णं कालं रुधिरं रोगनाशनम् ॥ ६० ॥
 यत्पिदं सर्वधातूनाम् अक्षीभ्यं जलवर्द्धिषु ।
 वर्द्धिदं वर्द्धिवीजं च सर्वधातुसहायकम् ॥ ६१ ॥
 एतानि लोहनामानि ज्ञात्वा कर्माणि कारयेत् ।
 जायते^१ सकला सिद्धिर्वियोगयोगसंयुता^२ ॥ ६२ ॥
 नामानि धातुसंयोगे जातानि तानि च मृणु^३ ।
 शुक्लखर्परसंयोगे जायते पित्तलं शुभम् ॥ ६३ ॥
 पित्तलं चैव नारीकं कफदं गन्धदुर्लभम् ।
 वर्णदं दुर्ललं चैव राजतं वज्रमं लघु ॥ ६४ ॥
 वज्रताम्रसंयोगेन जायते तेन^४ कांस्यकम् ।
 कांस्यकं कोमलं चैव नेरमं रसकाठिनम्^५ ॥ ६५ ॥

(1) A reads नीयते.

(2) विषीगाद्योऽन is the variant in A. विषीगाद्योऽन is the variant in B. Both the readings seem to be incorrect.

(3) जातानि अ ते मृणु, an incomplete variant in A and B.

(4) A has जातनेद. B has जातने तेनैद.

(5) A and B read erroneously कठिनं.

तीव्रनादं महाशब्दम्¹ उपकान्ति रविग्रहम् ।
 ज्वालापिधानं रौद्रं च ग्राहकं² धूमरोधनम् ॥ ६१ ॥
 एतानि³ कांक्ष्यनामानि कार्यकाले प्रयोजयेत् ।
 वन्धने धारणे चैव मुद्रणे धूमवन्धने ॥ ६७ ॥
 खर्परैः सह पारदं दिव्यं⁴ किञ्चित् प्रमेलयेत् ।
 जायते रसको नाम नानारोगहरो भवेत् ॥ ६८ ॥
 नागस्तु रक्ते⁵ क्षोभो मृतधातुस्तु जायते ।
 स एव कीमलान्निष्ठः⁶ सिन्दूरं जायते ध्रुवम् ॥ ६९ ॥

(1) A reads महाशब्दं. B reads महत्शब्दं. Both the readings are incorrect.

(2) A reads ग्राहकं, which has no clear sense.

(3) And B read एतानि, which is incorrect.

(4) पारदी दिव्यी is the reading in A and B, which is incorrect.

(5) B reads रक्ते, which is not correct.

(6) कीमलानिष्ठे is the reading in A and B. which is not correct.

एनेकाः^१ साधयेद्दिया मन्त्रयन्त्रकरीः क्रियाः ।
 पूजनार्थं मम गुणाः सर्वे कल्पितरोचनाः^२ ॥ ७० ॥
 तास्वदाहजलैर्द्यौं जायते तुल्यकं शुभम् ।
 नाना रसायनी विद्या साधयेत् सा^३ सदैव हि ॥ ७१ ॥
 रसरसक(१) योगेषु राजमर्यादा जायते ।
 राजकं जायते नाम नारी राजकसागतिः^४ ॥ ७२ ॥
 संयोगे साधनं दिव्यं वियोगे साधनं शुभम् ।
 वियोगं पुनर्नैर्द्यौं रसतास्त्रे शुभी विधिः^५ ॥ ७३ ॥

(1) A reads एनेका. B reads एनेका. Both are incorrect.

(2) A and B read कल्पितरोचनं.

(3) सा is not found in A and B.

(4) A and B read रसरसयोगेषु, which is incomplete.

(5) नाराराजकसागतिः, a variant in A. नाराजकसागतिः, a variant in B. Both the readings seem to be incorrect.

(6) A and B read पुनर्विधिः.

अनेका साधनीं विद्या साधयेद्द्व्यकाङ्क्षितम्¹ ।
 लभते रसायनीं विद्यां स्वस्थोऽपि विज्ञतोद्यमी ॥७४॥
 अनेनेव प्रकारेण ज्ञायते नाम कर्मभिः ।
 नामकर्मज्ञता² जाते चित्ते निर्मलता³ भवेत् ॥७५॥
 एतत्ते कथिता धातोरुपधातोस्तु ता⁴ शृणु ।
 येन विज्ञानमात्रेण कालकाव्या⁵ न लिप्यते ॥ ७६ ॥
 उपधातोस्तु मध्येषु ग्रहेहा माता रसायनी ।
 तस्या नामानि वक्ष्यामि पश्चात् स्थानगुणानपि⁶ ॥७७॥

(1) A reads द्व्यकीङ्क्षितः. B reads द्व्यकाङ्क्षितः.

(2) A and B read नामकर्मज्ञाने, which is unintelligible.

(3) A and B read निर्मलता, which is not grammatically correct.

(4) A and B read ते, which is incorrect.

(5) A reads कालकाव्य. B reads कालकाव्य. Both the readings are incorrect.

(6) Both A and B read गुणानि च, which is incorrect.

हरितालं विसङ्गा च रङ्गदीप्तिकरी सदा ।
 तालं च हरिता हंसी श्वेतपौतविधायिनी ॥ ७८ ॥
 नर्तकस्य प्रिया देशी निशा चैव निशाचरी ।
 पारदस्य चयकरी पञ्चच्छेदकरी स्मृता^१ ॥ ७९ ॥
 रोगहा जीविनी जेली जरादारिद्र्याश्रिनी ।
 एतानि तालनामानि संक्षेपात् कथितानि तै^२ ॥ ८० ॥
 युक्ती ज्ञानेन यः^३ कर्त्ता अक्षोभ्यो^४ जायते सदा ।
 अनेनैव प्रकारेण कर्त्ता कर्माणि साधयेत् ॥ ८१ ॥
 मनःशिला शिला शृङ्गी कुनटी च कृतोद्यमा ।
 दरदा^५ भगिनी देशी सिन्दूरस्य सखी सदा ॥ ८२ ॥

(1) The 78th and 79th slokas are not found in A.

(2) संक्षेपे विषयान्विज्ञे, a variant in A and B, which has no sense.

(3) युक्तज्ञानेन ये, an incorrect variant in A and B.

(4) A reads अक्षोभ्यो, which is incorrect.

(5) B reads दीरदा.

पुष्पा पुष्पवती¹ पत्नी शालिनी रसिनी सुधा ।
 एतत्तु च शिलानाम² कार्यकाले प्रयोजयेत् ॥८३॥
 अभ्रकं चैव व्योम³ च गगनं ग्राहकं परम् ।
 दुष्टवीर्यं वातश्च वज्रिनादोन्नताकृति⁴ ॥ ८४ ॥
 अजरम् अमरं घोरं घोरघटत्व⁵नाशनम् ।
 रंसमूलरसातीतं रसघ्ने राज्यवर्द्धनम् ॥ ८५ ॥
 अमृतम् अमरं⁶ चैव महासृष्ट्यविनाशनम् ।
 एतान्यभ्रकनामानि ज्ञात्वा कर्माणि कारयेत् ॥८६॥
 सोमलं मङ्गराजं च विषं वातविनाशनम् ।
 श्वेतवीर्यं बलप्रदं नीलवज्रलकारकम् ॥ ८७ ॥
 खेदनं भेदनं चैव कामवीर्यविवर्द्धनम् ।
 बन्धनं सर्वधातूनां मारणं पारदे रसे ॥ ८८ ॥

(1) A reads पुष्पवती.

(2) एतत्तु च शिला नामान्, an incorrect variant in A and B.

(3) Generally used as व्योम.

(4) A reads वज्रिनाद् एहः चतिः, which is incorrect.

(5) A and B read खड्ग, which is incorrect.

(6) A repetition of the name.

गगनवाहके दिश्ये रसयुग्मे प्रमेलनम् ।
 एतानि मङ्गनामानि कार्यकाले प्रयोजयेत् ॥ ८८ ॥
 हीनधातोश्च नामानि संक्षेपात् तानि च मृणु^१ ।
 येन विज्ञानमात्रेण जायते पारदो क्रिया ॥ ८९ ॥
 मुक्ता मुक्ताफलं कारि वारिजं स्वातिसम्भवम् ।
 शुक्तिगर्भे^२ च सगरं मृत्तारं मङ्गलोदयम् ॥ ९० ॥
 तैजसम्^३ अमृतोद्भूतं शीतलं शिलीर्म मनः^४ ।
 स्वयम्भवं कलं दीप्तं स्त्रियि सौभाग्यदायकम्^५ ॥ ९१ ॥
 रतिराजग्रहः शोभाकामसन्दीपनं तथा ।
 मुक्तानामानि रम्याणि^६ ज्ञात्वा कर्माणि कारयेत् ॥ ९२ ॥

- (1) A reads रते मृणु, which is incorrect.
- (2) B reads शुक्तिगर्भे, which is not correct.
- (3) B reads तैजसं, which is incorrect.
- (4) B reads मनः, which is not correct.
- (5) स्त्रियि सौभाग्यदायिन्, an incorrect variant in A and B.
- (6) A and B read ते रम्यान्, which is incorrect.

विद्रुमं वरदं¹ विलावल्लीजातं प्रबालकम् ।
 नीरसम्² अधरेसीमा शिखरं शिखरोद्भवम् ॥ ८४ ॥
 वर्णदं विवरं³ चैव शैवेयं⁴ च विभूषणम् ।
 विद्रुमस्येतनामानि⁵ कार्यकाले प्रयोजयेत् ॥ ८५ ॥
 कर्मकं कूर्मकं⁶ चैव कमठपृष्ठं सकालकम् ।
 कमठं कर्कशं⁷ चैव कलिङ्गजातं⁸ माशुभम् ॥ ८६ ॥
 कचकं कदहः⁹ कर्म लोके कचकटं तथा ।
 एतानि कूर्मपृष्ठस्य नामानि च विशेषतः ॥ ८७ ॥
 गङ्गं¹⁰ च जलजं चैव देववादिदमेव च ।
 विशुवल्लभकं¹¹ चैव सोमदैवतकं शुभम् ॥ ८८ ॥

- (1) A reads विद्रुमे वरदं. B reads विद्रुमे वरदे.
- (2) A reads नीरसे.
- (3) A and B read शैवेयं.
- (4) A has विद्रुमेनावि. B has विद्रुमेनावि. Both are incorrect.
- (5) कर्कशमाशुभं is an incomplete variant in A and B
- (6) A has कचककदहः. B has कचककदहः.
- (7) B reads erroneously विशुवल्लभाभकं.

वरायुर्वं च वरदं शुभं माङ्गल्यदायकम् ।
 अजेयं सर्वजस्तूनां दानवास्त्रि वरोदयम् ॥ ८८ ॥
 गम्भीरं घोषशब्दं च पवितं पारदं गृहम् ।
 एतानि^१ शंखनामानि वामदक्षिणकायभौ^२ ॥ १०० ॥
 युक्तिका सौफिका^३ कास्ती मुक्तामाता गरीयसी ।
 चन्द्रपत्नी पयोग्राही संपुटी पटवादिनी ॥ १०१ ॥
 रजताभासिनी दीप्ता वङ्गवारिविशोषणी ।
 पद्मकरीगतिः पद्मगर्भ^४ समुद्रसन्धवा ॥ १०२ ॥
 उत्तमा मध्यमा नीचा त्रिविधा सागरीद्वया ।
 नद्यद्वया तु सा नीचा^५ नीचकर्मविशारदा ॥ १०३ ॥

(1) Both A and B read वरं देव, which destroys both grammar and metre.

(2) A and B read एतन्, which is grammatically incorrect.

(3) A reads वामदक्षिणकायौ. B reads वामदक्षिणकायभौ.

(4) B has only सौका.

(5) A and B read पद्मेकर्म

(6) नद्यद्वया तद्योवा, an incomplete variant in A.
 नद्यद्वया तयोवा, an incorrect and incomplete variant in B.

एतत्तु लक्षणं श्लोः^१ कर्मकाक्षे प्रयोजयेत् ।

ज्ञात्वा यः कुरुते कर्म सिद्धयेत् सकलं फलम् ॥ १०४ ॥

गजोद्धवं रदं^२ दत्तं द्विजं चैव तु पुण्यकम् ।

नारीसौभाग्यदं चैव गजभूषणसम्पन्नम् ॥ १०५ ॥

तैलरक्षाकरं शीदं संपुटं पुष्टिकं तथा ।

नामानि गजदन्तस्य अन्यानि मध्यमानि च^३ ॥ १०६ ॥

पिच्छकं कुक्कुटं च व शिखिपिच्छं सुचित्रकम् ।

हरिमौलिधरं शीदं मोहनं चन्द्रकं तथा ॥ १०७ ॥

नागारिं सर्पदमनं विषदं विषनाशनम् ।

एतानि शिखिपिच्छस्य नामानि विविधानि च

॥ १०८ ॥

(1) A and B read एतत्तु लक्षणं श्लोः, which is an incorrect variant.

(2) कर्मकाक्षे प्रयोजयेत्, a variant in A, which seems to be incorrect.

(3) A reads रदं, which is incorrect.

(4) अन्यानि मध्यमानि च, a variant in A and B, which is grammatically incorrect.

नखं सङ्घटयपुरं^१ धातुकीमलकारणम्^२ ।

वज्रं^३ दुर्गन्धिकं चैव तुरीटापस्तु लोभकम्^४ ॥१०८॥

कचं केयं च बालं च सूर्देजालकमेव च ।

श्मामं चैव घनं प्रोक्तं कर्कशं नर्मदं लघु ॥ ११० ॥

एतानि धातुनामानि यथाकर्मोभिधानकम् ।

ज्ञात्वा चारभ्यते कर्मै स्वस्थे सिद्धिः प्रजायते ॥१११॥

पाश्चत्युवाच ।

यश्चो यक्कर विच्छेद्य विघ्ननाय जगद्गुरो ।

श्रुतानि चैव नामानि स्थानानि कथ्यन्तां^५ प्रभो ॥११२॥

(1) न सङ्घटयपुरं, a variant' in A- न सङ्घटयपुरं, a variant in B. Both are incorrect.

(2) B reads कारकं.

(3) B reads वज्रं, which is not correct.

(4) A reads तुरीटापस्तुलोभकं.

(5) A and B read कथ्यन्तां, which is grammatically incorrect.

महादेव उवाच ।

शृणु देवि प्रयत्नेन स्नानानि विविधानि च ।

सुवर्णस्योदयो धातोः सर्वव्यापकपर्वते ॥ ११३ ॥

पार्थिव्यं हि च तत् सर्वं सृष्टामध्यात् प्रजायते ।

तस्मात् स्नानस्य संक्षेपः श्रूयतां सादरं शुभे ॥ ११४ ॥

हेमं च प्रथमं कर्त्तुं मेरुमध्ये सदैव हि ।

दुर्लभं मर्त्यलोकेषु कष्टेनैव तु लभ्यते ॥ ११५ ॥

पुनर्जन्मादिषा तेन जायते सर्वदा शुभे ।

महाशैतिल्ये तेन दुर्लभं स्यात् सदैव हि ॥ ११६ ॥

पश्चात्तन्मूत्रदोहृतं जम्बूद्वीपेषु जायते ।

तच्च कष्टतरं मन्ये दुर्लभं तत् सदैव हि ॥ ११७ ॥

(1) A reads वनीत. B reads वनीत. Both the readings are incorrect.

(2) पार्थिव्यानि च ते सर्वे, an incorrect variant in A and B.

(3) A and B read सादरम् which is incorrect.

(4) A reads महत्शैतिल्ये, which is incorrect.

(5) B reads सदैव हि, which is incorrect.

पृथिव्यां धातुमध्येषु सर्वेषामधिकं सदा ।
 लोहाधिकतरं तत्र ज्ञातव्यं सर्व्वदा शुभे ॥ ११८ ॥
 कष्टे निःसारणं तेषां मौल्यादधिकं जायते ।
 तस्मात्तेनेव यत्नेन साधनं क्रियते नरैः^१ ॥ ११९ ॥
 असाध्यसाधनं तस्य ज्ञातं सर्व्वयुगे शुभे ।
 तस्मात्^२ बहुमुख्येन सर्व्वधातूपरिस्थितिः^३ ॥ १२० ॥
 पुनः स्थानं कृतं तेन लङ्कायां च रुदैव हि ।
 उद्धृतं तेन यत्नेन मर्त्ताद्भीतं मया शुभे ॥ १२१ ॥
 पार्व्वत्सवाच ।
 महारुद्र शङ्कर श्रीमान्^४ लोकनाथ जगत्पते ।
 कथं ते मानुषे भीतिः^५ कथ्यतां परमेश्वर ॥ १२२ ॥

(1) A has कथ्यते नराः. B has कथ्यते नराः. Both are incorrect.

(2) A and B read तस्मान्, which is incorrect.

(3) सर्व्वधातूपरिस्थितिः, an incorrect variant in A and B.

(4) A and B read erroneously सवाच.

(5) श्रीमान्, a reading in A and B, is not correct.

(6) मानुषाद्भीतिः is the correct form.

महादेव उवाच ।

सुवर्णश्लेषा महती^१ भीतिर्मानुषसम्भवा ।

उच्चो नीचपदं सम्यक् जायते बहुले रतिः ॥ १२३ ॥

मया मानुषभीतेन^२ उद्धृतं सादरेण च ।

दुर्लभं च विशेषेण प्राक् कलियुगे इदम्^३ ॥ १२४ ॥

पार्वत्युवाच ।

मदीये मानसे नाथ जातोऽसौ संशयो महान् ।

भवतां मानुषी भीतिः कथं तु जगदीश्वर^४ ॥ १२५ ॥

महादेव उवाच ।

कारणं वर्तते देवि अघ्याख्येयं सदेव हि ।

कथनीयं त्वयि भद्रे यत्तत्त्वं^५ मम वक्त्रभा ॥ १२६ ॥

(1) A and B read सुवर्णश्लेषा महतीन्, which is not correct.

(2) मां च मानुषीभीतेन, an incorrect variant in A and B.

(3) A and B read रतिः. This foot is incomplete.

(4) A reads कथं ते जगदीश्वर. B reads कथं ते जगदीश्वर.
Both are incorrect.

(5) यत्तत्त्वं is an incorrect variant in A and B.

बुद्धिचतुरतादृष्टिर्जायते च कलौ युगे ।
 मानुषे च भवतीह^१ मम श्रीमानुवर्त्तिनी ॥ १२७ ॥
 तस्मात्तैर्वहुले^२ द्रव्ये साध्यते गन्धकी क्रिया ।
 यथा पारदी चेव मम श्रीमानुवर्त्तिनी ॥ १२८ ॥

पार्वत्युवाच ।

युता सा गन्धकी विद्या सर्वसौभाग्यदायिनी ।
 सङ्गभक्षकता सा च^३ न सिध्यति गरीयसी ॥ १२९ ॥
 भवता पूर्वमुक्तं हि सङ्गभक्षणयोगतः ।
 न सिध्यति च ते विद्या सदा गन्धकपारदी ॥ १३० ॥
 तस्मान्नु कथ्यतां देव मनो^४स्तानिविवर्जितम् ।
 सुवर्णसाधिनीं विद्यां^५ तस्मादुपदत्तु मे विभो ॥ १३१ ॥

- (1) A and B read भवतीह, which is not correct.
- (2) A and B read तस्मात्ते, which is incorrect.
- (3) A and B read ते च.
- (4) A reads मत.
- (5) A and B read सुवर्णसाधिनी विद्या.

महादेव उवाच ।

मानसं मदीयं देवि जातं सम्यक् सुनिर्मलम् ।

तथापि मानुषे भौतिर्विद्या¹ गन्धकपारदी ॥१३२॥

सङ्गभक्षणजं कष्टम्² उभे मेलापनं महत् ।

सुप्तु मन्त्रकृते वक्रौ ज्वलते तत्क्षणात् ततः ॥१३३॥

मन्त्रवत् साधयेद्विद्यां साधयेद्व्यक्ततः क्रमात् ।

तस्मात्तेनैव महता गोप्या सिद्धिकरी क्रिया ॥१३४॥

पार्वत्युवाच ।

पुरा प्रोक्तं त्वया नाथ पटले पञ्चदशके³ ।

केलासात् परमं सौख्यं भजते मन्त्रविज्जनः ॥१३५॥

क्रिया गन्धकिनी⁴ मध्ये अथवा पारदी शुभे ।

केलासादधिकं सौख्यं भुञ्जते विधिवच्चराः⁵ ॥१३६॥

(1) A and B read विधे, which is senseless.

(2) A and B have कष्ट, which is incorrect.

(3) पटले पञ्चदशके, a variant in A and B, which is incomplete.

(4) A and B read गन्धकिना.

(5) A and B read चरा, which is incorrect.

महादेव उवाच ।

निर्मलं मानसं जातं तव वाक्यविमोहितम् ।

कथयामास ते भद्रे मुण्डलक्षणसंयुतम्¹ ॥ १३७ ॥

स्वर्णोत्पत्तिस्थलं² नित्यं सर्वत्रापि विधीयते ।

उत्पादनगतिस्तस्य स्थाने स्थाने पृथक् पृथक् ॥ १३८ ॥

श्रूयतां वरदे देवि स्वामं चैव यथोदितम् ।

तस्य वातोत्पत्तिरेषुर्धमने स्वर्णं³ जायते ॥ १३९ ॥

पावकाद्रेभुवावाद्⁴ समरत्नाकरे तथा ।

समुद्रस्य तटे दिव्ये स्थानं स्वात् स्वर्णकस्य च ॥ १४० ॥

स्वर्णं च सिन्धुदेशेन कामरूपैस्तथैव च ।

अन्येस्तु विविधेः स्थानैः साम्प्रतोत्पत्तिर्जायते ॥ १४१ ॥

(1) A and B read रयुतः, which is not accurate.

(2) Both A and B read स्वर्णोत्पत्तिः स्थलं, which is not correct.

(3) A and B add च after स्वर्णे.

(4) A reads पावकादस्य भुवावाद्. B reads पावकादस्य भुवावाद्.

तत्र तत्रोत्पत्तिस्तेषां यत्र यत्र हिमद्रवः ।
 प्रसरन्ति भुवि संघाः^१ संशयो नास्ति ते सदा ॥ १४२ ॥
 ताम्बोत्पत्तिश्च महता सुखेनैव प्रजायते ।
 तेषां स्थानानि वच्छेदं^२ याथातथ्येन च शृणु^३ ॥ १४३ ॥
 नेपाले कामरूपे च^४ वङ्गले मदनेश्वरे^५ ।
 गङ्गाद्वारे मलादौ च स्नेच्छदेशे तथैव च ॥ १४४ ॥
 पावकादौ जीर्णदुर्गे रुमदेशे फिरङ्गके ।
 एतान्युदितस्थानानि^६ सर्वपर्वतके^७ सदा ॥ १४५ ॥
 जासत्वं यत्^८ दिव्यं हि स्थानानि तस्य च शृणु ।
 कुम्भाद्रावय^९ काम्बोजे रुमदेशे बलवति ॥ १४६ ॥

- (1) संघे is the variant in A. संघे is the variant in B.
- (2) स्थानान् वपच्छेदं is the incorrect variant in A and B.
- (3) A and B read ते शृणु.
- (4) नेपालं कामरूपं च, a reading in A and B.
- (5) वङ्गालं मदनेश्वरं, a variant in A and B.
- (6) एतानि उदितस्थानानि, an incorrect variant in A.
- (7) A and B read सर्वपर्वतके, which is incorrect.
- (8) A and B read यत्.
- (9) A and B read कुम्भाद्राय, which is incorrect.

एतान्मुभयोः स्थानानि^१ रजःस्थानं च^२ उच्यते ।

जासत्वं वङ्गले नामं नेपाले च सदैव हि ॥ १४७ ॥

केदारि कर्मकाण्डे च त्राम्बके त्रिपुरे तथा ।

एतत्स्थानानि दिव्यानि^३ गोप्याम्यन्यानि

तानि ह^४ ॥ १४८ ॥

लोहाद्रौ^५ लोहलत्कर्मा गयाद्रौ^६ गौतमाद्रिके^७ ।

विन्ध्यामध्ये^८ हि सर्व्वेव नलाद्रौ^९ निष्कलेऽपि वा

॥ १४९ ॥

(1) एति उभयोः स्थानान्, a reading in A. एति उभयोः
स्थानान्, a reading in B.

(2) A and B read रजस्थानानि.

(3) A and B read स्थानानान् दिव्यान्.

(4) चन्दा गोप्या तितेति च, a variant in A and B, which
is senseless.

(5) A and B read लोहादे, which is incorrect.

(6) Do. Do. गयादे, Do.

(7) Do. Do. गौतमाद्रिके, Do.

(8) Do. Do. विन्ध्यामध्ये, Do.

(9) Do. Do. नलादे, Do.

त्र्यम्बके विमले^१ चैव लोहाकशालिवाहने ।
 समुद्रस्य तटे रम्ये आद्ये अन्ते च मध्यगौ ॥ १५० ॥
 लोहस्यैतानि स्थानानि^२ हाटकैश्च^३ सदैव हि ।
 किञ्चित्^४ गोप्यानि दिव्यानि संस्कारैः रक्षितानि च^५
 ॥ १५१ ॥

युक्ते तु संस्कृते तेषु स्वर्णौ सिद्धिः प्रजायते ।
 अयुक्ते नैव लभ्या तु^६ युक्ते प्राप्तिः सदैव हि ॥ १५२ ॥
 पारदे गन्धके धात्वोः योम औषधकृत्^७ सदा ।
 मानसे निर्मले चैव लभ्यते^८ हाटकी क्रिया ॥ १५३ ॥

(1) A reads विमले.

(2) लोहस्यैतानि च स्थानानि, a variant in A and B, which is incorrect.

(3) A reads हाटके च.

(4) किञ्चित् is the reading in A and B, which is incorrect.

(5) A reads से, B reads ते.

(6) A and B read लभ्यते, which is not correct.

(7) Do. Do. औषधीषधकृत्, Do.

(8) Do. Do. लभते, Do.

अन्यथा नैव लभ्या तु¹ विना मन्त्रेण सिध्यति ।
 तस्मादेवं प्रयत्नेन निर्मूलं मानसं शुभम् ॥ १५४ ॥
 अशुभं समलं चैव मानसं सर्वदा भवेत् ।
 तस्मात्तु चतुराहारे² सर्वदा शुभमानसः ॥ १५५ ॥
 जायते च क्रिया सिद्धा हाटकी भवति सर्वदा ।
 मन्त्रसिद्धिः प्रजायेत सर्वकर्मणि साधयेत् ॥ १५६ ॥
 अनेनैव प्रकारेण उत्तमा हाटकी क्रिया ।
 सर्वकार्यकरी नृणां चतुर्वर्गफलप्रदा ॥ १५७ ॥

महादेव उवाच ।

प्रोक्तमपुटके चैव खलु काचीयकेन च ।
 उष्णाङ्गारकते अस्मी³ सुमरं कागरेकजम् ॥ ८ ॥

- (1) A and B read लभ्यते, which is not correct.
- (2) A and B read तस्मादेवं, which is not correct.
- (3) A reads चतुराहारे, which is unintelligible.
- (4) A reads कृतेरपि. B reads चतेरपि.

खर्पराख्ये पुटे चैव आरख्योत्पलकेन च ।
 साहं विनास्ति(?)गति च ज्वलिते अर्द्धमर्द्धमे' ॥१०॥
 एवानुक्रमतो योगे पुटमैकं च जायते ।
 चतुरशेन जामत्वं सुवर्णादापयेत् सुधौः ॥ ११ ॥
 प्रति संपुटपुटे चैव उद्धयेत् कुण्डखर्परि ।
 स्वाङ्गगीतं' समुद्धृत्य लेपमुच्चारयेत्ततः' ॥ १२ ॥
 पुनर्लेपः प्रदातव्यः' पुनः चारान् प्रदापयेत् ।
 पुनरेव घोटनं देयं सादरं पुनरेव हि ॥ १३ ॥
 अनेनैव प्रकारेण तु ख्यांयसंपुटेन हि ।
 सुवर्णसंयुतं तच्च' गालयेत् चारसंयुतम् ॥ १४ ॥
 ज्वलिते तीक्ष्णयत्नेन तिस्राहं संपुटं प्रति ।
 नस्त्रीभूतं च रक्षये संस्कारैः शुध्य साम्प्रतम् ॥ १५ ॥

(1) A and B read ज्वलितेरर्द्धमर्द्धमे.

(2) साहंजीतेन is the reading in A and B, which is not accurate.

(3) A and B read लेपमुच्चारणं ततः, which is incorrect.

(4) A and B read पुनर्लेपं प्रदातव्यं, which is not correct.

(5) A and B read ते च, which is incorrect.

एतत्कमक्रमेणैव सुवर्णमनुसंलय ।
 तद्गुणे शोणमापीते महत्ततः प्रजायते ॥ १६ ॥
 आरक्तं पीतसंयुक्तं जायते हाटकं महत् ।
 हाटकं मत्तकं^१ चैव न च ह्रीनेन योजयेत् ॥ १७ ॥
 कलागुणगते वृद्धिर्जायते उत्तमे नरे^२ ।
 अनेनैव प्रकारेण मात्वादिगुणं दापयेत् ॥ १८ ॥
 कलावयवमिने वृद्धिर्दापिता वृद्धिरिष्यते ।
 निर्दोषं जायते दिव्यं द्रव्यसंपत्तिदायकम् ॥ १९ ॥

पार्श्वव्याच ।

अधिकेन कृतं तत्र^३ शोणपाने सुशोभने ।
 जायते कौटुशं देव संयोगे अधिके सति ॥ २० ॥

-
- (1) A and B read सुवर्णम्, which is not correct.
 - (2) A and B read हाटके मत्तके चैव.
 - (3) उत्तमी नरे, a variant in A and B.
 - (4) A and B have कलातर्क.
 - (5) A and B have न ज्ञ, which is incorrect.

महादेव उवाच ।

शोणपाने च संयोगे भद्रदः अस्ति¹ निश्चयः ।

द्विगुण² शोणपानेन कलकं जायतेऽशुभम्³ ॥ २१ ॥

वेधसंगं सुधनार्थे त्रिंशंगे दिक्पलोपमम् ।

अतिरिक्तकलं तच्च जायते सगुणं महत् ॥ २२ ॥

गालयेद्यज्ञपूर्व्वेण कायेद्रससमांशके ।

समांशे गन्धकं देयं शुद्धं पीतक⁴ रागकम् ॥ २३ ॥

चतुर्थांशकं तालं दापयेद्रसमोदितम् ।

तद्वर्द्धं सादरं देयं मर्ह्येत् कन्यकारसे ॥ २४ ॥

यामलितयमामर्ह्यं⁵ कायाशुष्कमण्डले रसे ।

अतिशुष्येतरं खल्वे पश्यवा सोऽहसंभवे ॥ २५ ॥

(1) A and B read भद्रदा अस्ति, which is incorrect.

(2) Do. द्विगुणे.

(3) Do. शुभं, which appears to be incorrect.

(4) Do. पीयत, which is senseless

यामलितयमामय, an incomplete variant in 'A and

(5)

मईयैद्यत्पूर्वेण क्वायाशोषितं कारयेत् ।
 काचकूप्ये प्रदातव्यं^१ वज्रिर्वातुकयन्त्रगः^२ ॥ २६ ॥
 नखसंख्यामिते यामे पाचयेद्द्रुमं शोभने ।
 स्वाङ्गशोते तु संजाते पुनः खल्ले निधापयेत् ॥ २७ ॥
 रसेनानेन आमर्द्दे क्वायाशोषितं कारयेत् ।
 उक्तयामे रसे^३ दत्ते पुनः शोषं^४ प्रदापयेत् ॥ २८ ॥
 उक्ताग्नी दापयत्येव पुनः संस्कारमाचरेत् ।
 संस्कारे त्रिविधे जाते अग्निपूर्वं क्रमोदिते ॥ २९ ॥
 जायते रसराजोऽसौ सर्वसामर्थ्यदायकः ।
 संचयेत्तण्डुलार्द्धे^५ अतिविक्रमवैभवान् ॥ ३० ॥
 जायते प्रवला बुद्धिः त्रिदिने सेवते यदि^५ ।
 सार्द्धं त्रिदिनेनैव दिने मासफलं सदा ॥ ३१ ॥

(1) प्रदातव्यं, a reading in A and B.

(2) वज्रग, a reading in A and B.

(3) रसी is the variant in A and B.

(4) शोषं is the incorrect reading in A and B.

(5) A and B read सेवनेपरि, which is grammatically incorrect.

जायते नात्र सन्देहः सिद्धिर्गन्धकसम्भवा ।

अनेनैव प्रकारेण रससिद्धिः प्रजायते ॥ ३२ ॥

* * * * *

पार्वत्युवाच ।

श्वेतता कर्मणा केन जायते रजतेषु च ।

क्रमेण राजतौ सिद्धिः पद्याद्वाटकसम्भवा ॥ ३८ ॥

महादेव उवाच ।

अद्यान्तरता विद्या धातुसंस्कारकारिणी ।

जासत्वे कठिने जाते शुद्धे कोमलकारिणी ॥ ३९ ॥

तथाच पीतशुक्लेषु जायते शुद्धनम्रता ।

मृणु यत्ने क्रिया दिव्याः शुद्धजासत्त्वसम्भवाः ॥ ४० ॥

पिष्टं हयसुरीत्यं च दिगुणं धातुतः सदा ।

मर्दन्तु दापयेत् स्त्रावे मर्दं निम्ने च" रक्षयेत् ॥ ४१ ॥

(1) केन कर्मण, an incorrect variant in A and B.

(2) जासत्वे is the reading in A and B, which is not correct.

(3) A and B read निम्नेन.

निर्मलं धातुजं द्वावं सावचूर्णेन ढालयेत् ।
 यदर्थं च स्थितं निम्बं तत्कालं दापयेत् सुधीः ॥ ४२ ॥
 उपरि संपुटं देयं समुद्रकुक्कुटे पुटे ।
 स्नाद्वाशीतं समुद्रतुल्य जायते निर्मलं महत् ॥ ४३ ॥
 जासत्वे सोमलं देयम् उल्लाभागेन^१ साम्प्रतम् ।
 चूर्णान्तरगतं कृत्वा उज्ज्वलं जायते महत् ॥ ४४ ॥
 तदेव^२ जासत्वं चैव दिव्यम् उज्ज्वलगं सदा ।
 रूप्याहं मेलयत्येव जायते शुद्धता शुभा ॥ ४५ ॥
 अनेनैव प्रकारेण धनं किञ्चिच्च जायते ।
 धने चैव तु संजाते कारयेद्दुर्हजाः क्रियाः ॥ ४६ ॥
 * * * * *
 अतीव शोभना विद्या रसगन्धकजा सदा ।
 अतिसौभाग्यदा सा^३ च साधके सुखदायिका ॥ ४७ ॥

(1) समुद्रं कुक्कुटे पुटे, a variant in A and B, which seems to be incorrect.

(2) उल्लाभागेन, a variant in A and B.

(3) A and B read स एव, which is not correct.

(4) Do. ३ Do.

एतादृशं च जासत्वं शोधितं गन्धकेन च ।
 धालधौतेन ताम्ब्रेण पुञ्जितं^१ सुभगं सदा ॥ ६८ ॥
 पुञ्जितं जायते दिव्यं शुक्लपीतं शुभोदितम् ।
 निर्धूलं जायते तच्च हीनघाटकसन्निभम् ॥ ६९ ॥
 लघुता जायते तस्य किञ्चिन्नाय्या गुरुता सदा ।
 जायते गुरुता दिव्या पुञ्जिते हाटकेन च ॥ ७० ॥

२८ श-पटलादुद्धृताः श्लोकाः ।

पार्श्वं लुवाच ।

पूर्वमुक्तं त्वया नाथ धने सिद्धिस्तु जायते ।
 लघुद्रवकृते धातो^२ वद^३ किं तन्न मुह्यते ॥ ४२ ॥
 महादेव उवाच ।
 क्रिया अग्नेः शुभा तेषां द्रव्यसिद्धिविधायिनी ।
 शृणु यत्नेन तां भद्रे क्रियां रंगीति नामजाम् ॥ ४४ ॥

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- (1) A and B read पुञ्जिते.
 (2) A and B read वाते, which is incorrect.
 (3) A reads वच. B reads वचः.

आनयेत् पारदं दिव्यम् अधर्द्धविपातितम् ।
 चालयेद्यत्नपूर्व्येण खले पिष्टं तु कारयेत् ॥ ४५ ॥
 तैलेनानेन आमर्द्धं भावना जगमात्रतः ।
 निम्ने डमरुके यन्त्रे अस्मिन् दद्याद्विचक्षणः ॥ ४६ ॥
 उत्थयेद्यामयुग्मेन स्नाङ्गशीतं समुदरेत् ।
 पुनः समाननागेन पूर्व्ववत् चालयेत् सुधीः ॥ ४७ ॥
 पुनरेव हठादग्नी उक्तयामेन मिहति ।
 रसे दिवारके चैव हीनहेमोत्तमोत्तमः ॥ ४८ ॥
 तौलिके रक्तिकाशुभं दापिते वर्णपञ्चकम् ॥
 अनेनैव प्रकारेण जायन्ते घोड्गज कलाः ॥ ४९ ॥
 द्रव्यवृद्धिकरं तच्च जायते नात्र संशयः ।
 पुनरेव क्रिया रम्या पारदे नागचारिणी ॥ ५० ॥
 द्विगुणे चारिते तत्र जायते चन्द्रिका शुभा ।
 आभासेन शिखियोवा जायते नात्र संशयः ॥ ५१ ॥

(1) हीनहेमोत्तमः, an incomplete variant in A.

(2) पञ्चकः is the reading in A and B, which is incorrect.

(3) ते च is the incorrect reading in A and B.

पुच्छिते हीनहिमेन जायते क्रयविक्रयः ।
 अनेनैव प्रकारेण जायते धनसंपदः ॥ ५२ ॥
 अत ऊर्ध्वं क्रिया या च विद्या नागस्य संभवा ।
 रसे तु नागजे चैव विधिनानेन वर्तते ॥ ५३ ॥
 तायते सकला विद्या नागतैलस्य संभवा ।
 सर्व्वा सा शोभना विद्या तीव्रदारिद्र्यनाशिनी ॥ ५४ ॥
 अथातः संप्रवक्ष्यामि त्वपूर्णा विधिमुत्तमम् ।
 येन विज्ञानमालेख जायते रजतं महत् ॥ ५५ ॥
 अनेका राजसी सिद्धिः जायते परमोत्तमा ।
 जायते धनसिद्धिश्च जायते नात्र संशयः ॥ ५६ ॥

- (1) A and B read व च, which is incorrect.
- (2) A and B have त्ते, which is incomplete.
- (3) A and B have त्, which is notcorrect.
- (4) A and B have विधिरुत्तमा, which is grammatically incorrect.
- (5) A and B have छात् instead of च, which is a tautology.

पार्वत्युवाच ।

वद वैभवदातारं^१ वङ्गं विज्ञानदायकम्^२ ।

ज्ञात्वा सिद्धिमवाप्नोति गुणैः सौख्यकं च यम् ॥५७॥

महादेव उवाच ।

आनयेच्छोभनं वङ्गं विख्यातलसमुद्भवम् ।

गालयेद्यज्ञपूर्व्वेण दालेत् कृष्णगङ्गे रसे ॥ ५८ ॥

त्रिःसप्तककृतं तत्र^३ जायते निर्मलं शुभम् ।

तदुत्थान् कारयेत् पचान्^४ शुचिविद्वान् यथोदितान्

॥ ५९ ॥

रक्षयेद्यज्ञपूर्व्वेण आनयेद्वर्किकं^५ ययः ।

भावयेत् शुक्तिकाचूर्णम् उज्ज्वलं वह्निगोधितम् ॥६०॥

(1) दाता च, a variant in A and B.

(2) दायकः, a variant in A and B.

(3) ते च is the incorrect variant in A and B.

(4) A and B read तदीत्यन्, which is incorrect. The word पच is used here in the masculine gender.

(5) B reads वह्निर्क.

मर्दयेदुयन्नपूर्वण यावलेपः सुलक्ष्यते¹ ।
 यवाहं लेपयत्येव पत्रान् तु यन्नपूर्वकम् ॥ ६१ ॥
 कायाशुष्के च संजाते दापयेच्छक्तिमंषुटे ।
 चूडाधो लेपयत्येव सन्धौ यत्नेन मुद्रयेत् ॥ ६२ ॥
 मेलितौ माषगोधूमौ पिष्टलेपं प्रदापयेत् ।
 कायाशुष्के च संजाते मृक्षयं लेपं दापयेत् ॥ ६३ ॥
 सुशुष्के च² गजि पाच्यं स्वाङ्गशीतं³ समुदरेत् ।
 जायते उक्खलं वङ्गं वातशुष्कं तु कारयेत् ॥ ६४ ॥
 यः कश्चित् मूर्च्छितश्चैव⁴ जीवयेज्जीवनक्रियाम् ।
 स हि वङ्गाययेनैव⁵ उक्खलः कठिनो⁶ भवेत् ॥ ६५ ॥

(1) यावत्तपस्य लक्षणे, a variant, which seems to be incorrect.

(2) सुशुष्केन, a variant in A and B.

(3) स्वाङ्गशीते, a variant in A and B.

(4) ये केचित् मूर्च्छिते ते च, an incorrect variant in A and B.

(5) सङ्कर्मणावयेन, a variant in A and B, which is unintelligible.

(6) A and B read उक्खलं कठिणं, which is incorrect.

अतिशुद्धतरं तच्च जायते नात्र संशयः ।
 सर्वकर्मकरं श्रेष्ठं नानाभागेन पुञ्जितम् ॥ ६६ ॥
 भोगभागसमायुक्तं वङ्गं च गुणसंयुतम् ।
 लक्षणार्थे^१ धनार्थे च^२ संयोगे साधयेत् सदा ॥ ६७ ॥
 जायते सुभगं तच्च संसारे शोभनं भवेत् ।
 अनेनैव प्रकारेण जायन्ते धनसम्पदः^३ ॥ ६८ ॥

पार्वत्युवाच ।

अथौ शुद्धतरं जलं का क्रिया वद मे विभो ।
 लक्षणार्थं धनसंपत्तेः क्रिया या च पृथक् पृथक् ॥ ६९ ॥
 महादेव उवाच ।
 लक्षणेन^४ च नारीणां भिक्षा भिक्षेन वर्त्तते ।
 अनेका धनदा विद्या जायते सुभगा मङ्गत् ॥ ७० ॥
 अतौव शोभना सा च गुणसामर्थ्यदायिका ।
 येन विज्ञानमात्रेण साधके धनसुप्तमम् ॥ ७१ ॥

- (1) B reads लक्षणार्थं.
 (2) धनार्थं is omitted in B.
 (3) जायते धनसंपदा, a variant in A and B.
 (4) A and B read लक्षणेन.

जायते नैव सन्देहो धनसामर्थ्यकं सहत् ।
 अतिसौभाग्यमप्यतिर्जायते नात्र संशयः ॥ ७२ ॥
 आनयेत् शुद्धं तं वङ्गं मालयेत् टङ्कणैः सह ।
 पिष्ठाकसुरसे दिव्ये ढालयेद्यज्ञपूर्वकम् ॥ ७३ ॥
 समढालकृते शुद्धे कठिनं रजतोपमम् ।
 जायते नैव सन्देहः पुष्किले रजते शुभे ॥ ७४ ॥
 रजतं जायते शुद्धं संभारं कारयेत् सुधीः ।
 अन्येष्वेव विविदिष्यो दिव्यरजतसंभवः^१ ॥ ७५ ॥
 आनयेत् शोधितं वङ्गं तदहं पारदे कृतेत् ।
 निधाय^२ शोभने खले तुर्व्यांशे दापयेत्ततः ॥ ७६ ॥
 मर्दयेत् कन्यकावौर्यं यामं षोडश यज्ञतः ।
 हंसपद्या रसे दिव्ये तत्समं मर्दयेत् सुधीः ॥ ७७ ॥
 समानाण्डरसेनैव मर्दयेद्यज्ञपूर्वकम्^३ ।
 कायाशुष्के च^४ संजाते शोषान्ते^५ बालके पचेत् ॥ ७८ ॥

(1) दिव्यादिव्यं रजतसंभवः, a variant in A and B.

(2) A and B read निधाय or निधाय.

(3) यज्ञपूर्वकः, a variant in A and B.

(4) कायाशुष्केन, a variant in A and B.

(5) A reads शोषान्ते. B reads शोषान्ति.

अग्नेर्नैव प्रकारेण क्रमादग्निं प्रदापयेत् ।
 पहराष्टकेऽष्टकेनैव त्रिवारं हठं दापयेत् ॥ ७८ ॥
 जायते च रसं दिव्यं भक्षणे च सुधाममम् ।
 नारीणां दापयेद्यत्ने संयोगे नामकेसरैः⁽¹⁾ ॥ ८० ॥
 तदर्धाः सुष्टु गोधूमाः सहैवं तोलकार्द्वयम् ।
 अतिसौख्यकरं तच्च⁽²⁾ रक्तिमात्रादे वर्द्धते ॥ ८१ ॥
 पुंसि अजगुणोपेतं यथा च गंधकी गतिः ।
 नरार्थं भक्षणे यातो जातित्रयसमन्वितः ॥ ८२ ॥
 अग्नेर्नैव प्रकारेण क्रमेण वर्द्धयेद्रसम् ।
 जायते रसजा सिद्धिः नात्र कार्या विचारणा ॥ ८३ ॥
 सुकृत् सुधाकरं वर्द्धं गालयेद्यत्नपूर्वकम् ।
 तज्जलं शोषयत्येव शतांशे रसदापिते ॥ ८४ ॥
 रजतं जायते शुद्धं कलाहानिशतः स्फुटम् ।
 अन्यं वै मेलयत्येव विक्रये शुभदं महत् ॥ ८५ ॥

(1) A reads नामकेसरै.

(2) B reads त्रिषु.

(3) A and B read ते च, which is incorrect.

अनेनैव प्रकारेण जायते धनसंपदः ।
 साधयेत् सिद्धिदा विद्या देहसामर्थ्यदायिनी ॥८६॥
 मेलयेद्भोगभागेन मर्हनाहरदो विधिः ।
 पीते भावनया अग्नौ' सार्द्धवृद्धेन सिद्धयेत् ॥ ८७ ॥
 शुद्धताम्रे प्रदातव्यं शतशे द्वाटकोत्तमम् ।
 जायते नात्र सन्देहो यथा जाम्बूनदीव्रवम् ॥ ८८ ॥

* * * *

पार्श्वव्याच ।

ताम्रं च तुल्यजं दिव्यं जायते केन विक्रियाम् ।
 यद् विश्वेश्वर शक्तो सिद्धिं ताम्रविधानकीम् ॥८४॥
 महादेव उवाच ।
 शृणु शुद्धक्रियां दिव्यां तुल्यताम्रस्य संश्रवाम् ।
 येन विज्ञानमात्रेण साधयेद्रसकुम्भिकाम् ॥ ८५ ॥
 साधयेत् पञ्चासृतं दिव्यं महासौख्यप्रदायकम् ।
 ज्ञात्वा कालेन लीयेत संसारसुखभाजने ॥ ८६ ॥

(1) A and B read रसौ, which is incorrect.

(2) सिद्धा ताम्रविधानक', an incorrect variant in A and B.

आनयेत्तत्सकं दिव्यं पीतगन्धकसम्भवम् ।
 दापयेच्छोभने खल्ले पक्वैर्घोरिण भावयेत् ॥ ६७ ॥
 मईयेद्यत्पूर्व्वेण याममात्रमखण्डितम्^१ ।
 तेनैव धातुयोगेन सुवर्णे^२ सुलभतां व्रजेत् ॥ ६८ ॥
 एतादृशो परा धातुर्वर्त्तते धातुर्मध्यमा ।
 सुलभा शुभदा प्रीता सम सान्निध्यमा मदा ॥ ६९ ॥

पाण्डित्यवाच ।

ये गुणा नागजे तान्मे वद विश्वस्य वज्रभ ।
 प्रयोजनवस्तु शक्यं चतुरेणैव चोदितम् ॥ ८५ ॥
 महादेव उवाच ।
 अनेका गुणा^३ नागेषु पूर्व्वसुक्ता हि^४ पारदे ।
 किञ्चित् शेषतरा ये च सृणु देवि प्रयत्नतः ॥ ८६ ॥

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- (1) A reads याममात्र मखण्डितः. B reads याममात्रे मखण्डितः.
 (2) A and B read सुवर्णः.
 (3) अनेकान् गुणान्, a variant in A and B.
 (4) सुकानि पारदे, an incorrect variant in A and B.

नागस्य सम्भवं तास्य मध्ये मेलापनं कृतम् ।
 विभागे तु कृते तत्र जायते कुम्पिका शुभा ॥ ८७ ॥
 तन्मध्ये गालयेद्योगं त्रिवारं यत्नपूर्वकम् ।
 जायते निर्मलं स्वर्णम् उदितं चैव कुम्पिके ॥ ८८ ॥
 विभागे साम्प्रतं दत्त्वा अमृतं जायते शुभम् ।
 उक्तकार्यकराद्यैर्नाम्यथा वचनं मम ॥ ८९ ॥
 तस्मात् साधयते दिव्यं भूनागोद्वज्रं शुभम् ।
 अनेका साधयेद्विद्या रससामर्थ्यादयिका ॥ ९० ॥

Colophon in A

इति श्रीरुद्रयामले उमामहेश्वरसंवादे सुवर्णकल्पे
 सुवर्णप्रशंसा नामाध्यायः ।

Colophon in B

इति श्रीरुद्रयामले उमामहेश्वरसंवादे धातुमंजर्यां
 सुवर्णप्रशंसा समाप्ता ।

(1) A and B read ते च, which is incorrect.

Extracts from
SUARNATANTRA

OR
SVARNATANTRA.

सुवर्णतन्त्रात् वा स्वर्णतन्त्रात्

उद्धृताः श्लोकाः ।

A = MS. from Benares. *

B = MS. from Rāmaṅkāli's matha, Dacca. †

श्रीगणेशाय नमः ।

श्रीराम उवाच ।

देवदेव महादेव ऋद्धिबुद्धिफलप्रद ।

पूर्वं संसृचिता ऋद्धो रमायनपरा परा ॥ १ ॥

यस्याः साधनमात्रेण स्माराट्पुण्यो नरो भवेत् ।

तां सिद्धिं वद मे देव यदि त्वं भक्तवत्सलः ॥ २ ॥

* The name of this MS. is सुवर्णतन्त्रम्.

† The name of this MS. is स्वर्णतन्त्रम्.

पूर्वं तु कथितं देव रत्नतन्त्रं त्वया मम ।
 गुटिकाः कथिताः पूर्वं सहस्रद्वितयं शिव ॥ ३ ॥
 पारदाः कथिताः पूर्वं षट्शतं मृतिरूपकाः ।
 धातूनामष्ट कल्पास्तु पूर्वमेव प्रकाशिताः ॥ ४ ॥
 धातुयोगाख्यकल्पस्तु पूर्वमेव प्रकाशितः ।
 रत्नानां करणे तन्त्रं पूर्वमेव प्रकाशितम् ॥ ५ ॥
 किन्तु स्वर्णाख्यतन्त्रं तु न मया कथितं प्रभो ।
 कथ्येन सहैशानाभ्यर्चितोऽस्मि महेश्वर ॥ ६ ॥
 भूमिदानं मया दत्तम् ऋषये कथ्यमाणं वै ।
 कथ्येन मयि प्रोक्तं भूमिभागं त्वज प्रभो ॥ ७ ॥
 स्थानार्थं तु सहैशान रक्ताब्धिः प्रार्थितो मया ।
 बाणमात्रं स्मृतं तेन दत्तं मम महेश्वर ॥ ८ ॥
 स्थानं प्राप्तं सहैशान भक्षणं मम नास्ति वै ।
 भक्षणं देहि मे देव यदि पुनोऽस्मि शङ्कर ॥ ९ ॥

ईश्वर उवाच ।

शृणु राम प्रवक्ष्यामि रहस्यातिरहस्यकम् ।
 स्वर्गतन्त्राभिधं तन्त्रं कल्परूपेण कथ्यते ॥ १० ॥

तत्राद्यं स्वर्णतन्त्रस्य कर्णं मृणु सुपुत्रक ।
 तैलकन्दाभिधः कन्दः सिद्धकन्दः पकीर्तितः ॥ ११ ॥
 कन्दः कमलवत्तस्य पत्राणि कञ्जवर्ष्मिणो ।
 तथैव तु महत्पत्रं तैलं स्रवति सर्वदा ॥ १२ ॥
 जलमध्ये सदा पुत्र त्वार्द्र एव प्रतिष्ठते ।
 विषकन्देति विख्यातो विषाच्च कायनाशनः ॥ १३ ॥
 तैलस्त्रायो महाकन्दः परितस्तैलवज्जलम् ।
 दशहस्तमिते देशे सरते तैलवज्जनम् ॥ १४ ॥
 महाविषधरः पुत्र तदधो वसति ध्रुवम् ।
 कन्दाधः कन्दच्छायायां नान्यत्र गच्छति प्रिय ॥ १५ ॥
 तत्परीक्षाविधानार्थं कन्दे सूचीं प्रवेशयेत् ।
 सूचीद्रावः क्षणात् पुत्र तत्कन्दन्तु समाहरेत् ॥ १६ ॥
 तत्कन्दं तु समादाय शुद्धसूतं खलेन्निधा ।
 मूषायां निक्षिपेत् तन्तु तत्तैलं तत्र निक्षिपेत् ॥ १७ ॥
 दौसाग्निं तु महाराज वंशाङ्कुरेण दापयेत् ।
 तत्क्षणाभ्युतिमायाति लक्षवेधो भवेत् सूत ॥ १८ ॥
 ततः प्रभक्षयेद्रामं क्षुब्धिद्राहारको ध्रुवम् ।
 तालं शुद्धं समानीय तत्तैलेन खलेत् सूत ॥ १९ ॥

सप्तधा प्रत्यहं राम त्वेषं विगृह्णन् भुवम् ।
 हरितालो मृतिमैति निर्धूमो जायते भुवम् ॥ २० ॥
 सप्तौ पुत्र ततो दद्यान्निर्धूमो जायते सुत ।
 तत्तलं चाष्टधातौ तु दद्याद्वावे कृते सति ॥ २१ ॥
 सर्ववेधो भवेदेव शतविद्धो भवेत् सुत ।
 तत्तलं तु समादाय ताम्रद्रावे विनिक्षिपेत् ॥ २२ ॥
 तत्क्षणात्ताम्रवेधः स्यात् दिव्यं भवति काञ्चनम् ।
 वज्रे कांस्ये यदा दद्यात्तदा रौप्यं भवेत् सुत ॥ २३ ॥
 ताम्ने लौहे तथा रौप्यां तारे खर्परसूतके ।
 तत्क्षणात् वैधमायाति दिव्यं भवति काञ्चनम् ॥ २४ ॥

* * * * *

शंखद्रावस्य भेदान् द्वि तत्कल्पान् शृणु साम्प्रतम् ।
 लौहद्रावस्तथा ताम्रद्रावश्चैव द्वितीयकः ॥ १ ॥
 शंखद्रावस्तृतीयः स्यात् क्षन्तालव(१) चतुर्थकः ।
 दम्सद्रावः पञ्चमः स्यात् शस्त्रवेधौ तु मध्यमः ॥ २ ॥

* The above 24 Slokas are not found in MS. A.

पश्चानां तु परीक्षा वे कथ्यते शृणु साम्प्रतम् ।
 लौहसूचीं समादाय लौहद्रावे विनिक्षिपेत् ॥ ३ ॥
 तत्क्षणाद्भवतां याति सा सूची नात्र संशयः ।
 ताम्बद्रावे तथा सूचीं सन्निभेदीं विनिक्षिपेत् ॥ ४ ॥
 सूचीद्रावो याममात्राद्भवत्येव न संशयः ।
 शंखद्रावे शंखसूची चतुर्यामिन संद्वेत् ॥ ५ ॥
 कृत्वालोऽधो^१ यदा गच्छेत् दन्ताश्चास्मा भवन्ति हि ।
 दन्तद्रावोऽप्यधो गच्छेद्दन्तद्रावो भविष्यति ॥ ६ ॥
 एवं परीक्षां कृत्वादौ प्रयोगानारभेद्ब्रह्मम् ।
 वज्रसूपां ततः कृत्वा शङ्खसूतं विनिक्षिपेत् ॥ ७ ॥
 लौहसूचीद्रावरसं तत्र यत्नेन निक्षिपेत् ।
 तत्राग्निं^२ दापयेद्यज्ञात् पुनस्तत्र^३ रसं क्षिपेत् ॥ ८ ॥

(1) The above 7 hemistichs are not found in A.

(2) A reads दन्ताधो. B reads दन्ताश्चाधो. Both the readings seem to be incorrect; since B has कृत्वाद्यधो in the 2nd Sloka.

(3) B reads पुनस्तत्र, which is not correct.

स सृतो सृततामेति¹ नात्र कार्या विचारणा ।
 अष्टधातुषु तं सृतं दत्त्वा काञ्चनतां व्रजेत् ॥ ८ ॥
 तं सृतं भणयेद्दयो हि सोऽमरत्वमवाप्नुयात्² ।
 तस्य मूलपुरीषेषु शुक्लं³ भवति काञ्चनम् ॥ १० ॥
 ताम्रद्रावप्रयोगं वै शृणु यज्ञेन साम्प्रतम् ।
 तद्रसं तु समादाय शङ्खताम्ब्रे विनिक्षिपेत्⁴ ॥ ११ ॥
 तत्ताम्ब्रं स्वर्णतां याति भैरवस्य प्रसादतः ॥ १२ ॥

Colophon in A—इति त्रौसुवर्णतन्त्रे हरपायंतीमन्वादे
 दुष्पर्याकल्पः द्वितीयः ।

Colophon in B—इति स्वर्णतन्त्रे लोहद्रावादियज्ञ-
 फलकण्डो द्वितीयः ।

- (1) B has सा सृतो कृतिमाप्नोति.
- (2) A reads स मण्डोदमरत्वतां, which is incorrect.
- (3) B reads शुक्ल.
- (4) शङ्खताम्ब्रे विनिक्षिपेत्, a variant in B.

INDEX OF PROPER NAMES.

A

A'dhamalla lxix, lxxi, lxxxix.
 A'kbar, Emperor, lxxix.
 Albertus Magnus 45.
 Albérúni xiv.
 Amarashikha ii.
 Amoghavajra xxxvi.
 A'nandánubhava xvi.
 A'ndhabhaktiyas xiii.
 Aniruddha 116.
 Archimedes 33.
 A'ryabhata I, xvi, xvi.
 Asanga xvi, xiv.
 Asuka, king, proclamation of,
 ix.
 Asvaghosha xv, xixiv,
 xxxviii.
 Atisa xixvii.
 Aufrecht lxxiv, xciv.
 Augustine 45.

B

Balubhadra xvi.
 Barth xlviii.
 Bauer 37, 39.
 Beal xxx, xlii.
 Bendall xxi, x.

Berthelot lxiv, lxxxi, lxxxvi,
 42.

Bhándárkar Dr., v, xxi.
 Bhāskara-A'chārya 162.
 Bhāskara, (Śiddha), xvi 60.
 Bhattotpala 39.
 Bhavabhūti i.
 Bhāvamāra lxxxix.
 Bhavyadattadeva xvi.
 Bhojadeva xvi.
 Boyls, Robert, 49, 53.
 Brahma Gupta i.
 Brahmajyoti iv, xvi.
 Buddhāmitra xvi.
 Bukān, king, ix.
 Buryia Nanjio, Catalogue of,
 xv, xxxiv, xxi, xxxvi,
 Burnell lxviii.
 Burnouf xxvii, xxxii, xxxiii, ii

C

Chakradatta 149.
 Chakrapāni xii, xv, lxxix,
 xvi, 42, 147.
 Chandraseva xvi.
 Charaka lxxvi, lxxix, 21, 60,
 120, 126, 130, 131, 140,
 146, 150.

Charpata xvi.
 Charpati, Siddha, lxi.
 Calabrooke xci, xcii.
 Cowell xxxiv, xxviii.
 Ceoma for Ceoma Korosi or
 Ceoma de Korosi xi, xvi,
 xxxviii.

D

Dalvaan 127.
 Dāmodara lix, lxx.
 Daniell lv.
 Dās, Naratchandra (S. C.)
 xix, xlii, xxxvii.
 Davida, Rhys, Professor, v,
 xvii, xxxiii, 48.
 De-Chya, king, xix.
 Democritus xlii.
 Devā xv.
 Devadatta lxxiv.
 Dhanaapati xvi, (Sūri) 58.
 Dharmakīrti xlv, xlii.
 Dhundhuanatha lxiii.
 Dignāga xxxvii.
 Digphaurus xci.
 Driddhabala 140.

E

Ekkin xxxiv.
 Emerson 47.
 Empedocles 48.
 England 46.

F

Fah-hian, travels of, xlix,
 xix, xlii.
 Finot, M., 41.
 Fleet xxi.
 Flückiger lxxvii.

G

Gahasinandanātha xcv.
 Garbe 30, 35.
 Garudadatta Siddha xvi.
 Geber xxiv, lxi.
 Gopālakrishna lxii, 56.
 Gorakhanātha xvi.
 Goudapa'da 58, 116, 119.
 Govinda lxiii, lxv, 21.
 Govindabha'gavat lii, lix.
 Govinda, Bhiksha, 12, age of,
 57.
 Govinda'cha'rya lxvii.
 Govindanātha Muni 66.
 Gupta Abhaya'nanda, lxxlii.

H

Hamminā, Ra'jā', lxx.
 Hanbury lxxvii.
 Harihara xvi.
 Ha'rīta lxxix.
 Hamauchandra xlii.
 Heraclitus 48.
 Hōmen, Thsang xv, xx, xli.
 Hipparchus xci.
 Horiozi xxxv.
 Havishta xi.

J

Jayadeva xxix.
Jayanta 60, 191, 198, 219.
Julien xv.

K

Ka'lana'tha lxiii.
Ka'lidā'sa l.
Kasa'da 49
Kasabha xi, xii, xxi, xxxiv.
Kaśka'ñ xvi.
Ka'nabhin xxv.
Kapa'ñ xvi.
Kavibha'ratī, Ra'machandra,
 xxix.
Kaye xcii.
Kera xxv, xxxii, xxxiv, xlvii.
 [xxxv].

Kesavadava xvi.
Kopp 45.
Kuma'salabha xv.
Kuma'rita 60.
Kushana, dynasty of xl.

L

Lakshmi'svara, Siddha, lxv,
 xov.
Lasson xxi, xciii.
Lavoisier 51.
Lucky 45.

M

Madanaratha 12.
Ma'dhava xlviii, xlix, lii,
 lxxviii.
Ma'dhavakara lxiii.
Maha'ra'shtra lxiii.
Malla'ri xvi.
Ma'nā'rya xi, lii, xlv, 8.
Mantba'nakhahava lvii. xov.
Mathanasimha li.
Mathura' xxi.
Mathura'na'tha 207.
Max Müller xxi, xcii,
 xxxiii, xlv.
Medici, the, xlvii.

N

Na'ga'rjuna, age of, i, xv;
 bodhisattva xv; the boy
 xvi, xviii; high priest of
 Na'lendra lix, 49; master-
 ed the Ma'dhyamika philo-
 sophy xix, 48; adept in
 magic, alchemy, &c. ix,
 lix, lrv; friendly epistle of,
 xli; contemporary of
 Sa'tava'hana or Sa'iva'hana
 lxiii, xli; author of books
 lxiv; a comprehensive
 name of Maha'ya'nism, xlv;
 dream of, xi, 5; debt of
 obligation to, lii, lv, lvii

ixii ; dialogue between, 6 ;
 identical with Siddha, 131.
 Na'landa' xlii, Na'lenda' xlix,
 Na'lendra xvii, xix ; cala-
 mity of, xvii ; Oxford of
 Indian Buddhism xxvii.
 Nandi or Nandin iv, lvii, xcv,
 16.
 Narahari xevi.
 Naya Pa'la, king, xxxvii.
 Nityana'tha, Buddha, lxi, lxxv.

O

Olympiodorus lxxxi.

P

Pao'jua-Sambhava xxxvii.
 Paracelsus 46, 48.
 Parama'rtha xxvi.
 Pa'taliputra xlix, xlii.
 Patañjali xxvi, xevi, 46, 49.
 Plato xxiv, 49.
 Pliny 36.
 Plotinus 47.
 Pra'nana'tha Siddha, xvi.
 Prasastapa'la, Bha'shya of,
 60 ; view of, 196, 215.
 Proclus lxxxi.
 Ptolemy xci.
 Purohana lxxiv.
 Pythagoras 44.

R

Raghuna'tha 60, 137, 218.
 Ra'machandra lxii.
 Ra'ma'muja i.
 Ra'mara'ja xevi.
 Ra'masena lxlii.
 Ratanaghesha xl, lii, xciv, 6.
 Ratnakarakita xlv.
 Ra'vana lxxi.
 Ray, Yogesa chandra, Prof.,
 39.
 Ripley, George, lxi.
 Rodwell lxi.

S

Sachau, Prof., xiv.
 Sadva'hana (= Bdyo-Spyod)
 xxii.
 Sa'ka'nda 3.
 Sa'kyamuni i.
 Sa'kyasi xlv.
 Sa'liana'tha lxxii.
 Sa'liya'hana or Sa'tava'hana
 xlii, xlv, xl, 6.
 Sambhu iv.
 Samkara i, (A'cha'rya), 57, 58,
 60, 175, 177.
 Sangama-Saijōana xvi.
 Sañkummarā 211.
 Sānti Rakshita lxxvii.
 Śārngadhara, date of, lxx, xc.

Sa'stri, Harapras'ada (H. P.),
xliii.

Schiefner xx, xxi.

Sewell xlix.

Siva'ditya, Supta-pada'rthi of,
186.

Smith, V., xxi.

Somadeva hv, lvi, xov, 16.

Spencer 35, 37, 39.

Sridhara 60, 188, 193, 198.

Srinu'tha xvi.

Sri Saraha Bhadra xvii, xix.

Stein, Dr., xi.

Sukadeva 58.

Susruta lxii, lxix, lxxviii,
21, 42, 127, 128, 130, 131,
140, 141, 147, 148.

Svachchhanda bhairava lvii,
lviii, xov, 21.

T

Takakasu xxvi.

Ta'ma' li.

Ta'ra'na'tha xv, xx, xlv.

Tatha'gata 12.

Tavernier, rule of, 40.

Temple, Sir William, 46.

Thibaut xxi.

Thomas, St., 45.

Trimallabhatta xvi.

Trivikramabhatta lxv.

U

Udandapura xlii, xli, xlix.

Udayana or Udayana'cha'rya
viii, 60, 117, 205, 206, 206,
209, 210, 211.

Udyan, King, xxii.

Uddyotakara, Va'rtika of, 60 ;
refutation by, 158, 192,
194, 205, 208, 210.

Uma'sva'ti, (Tattva'rtha'dhi-
gama of,) 183.

V

Va'cha'spati 60, 117, 119, 122,
123, 205, 209, 210, 212, 217.

Va'ghbata li, (pseudo) li, lxii,
lxix, 42, 147.

Vaidyara'ja xvi.

Vandimera xvi.

Vara'ha or Vara'hamibira

lxxiv, lxxvi, xci, 30, 33,
39, 40, Vrihat Samhita'
of, 60, 124, Vajra-lepa
(cements strong as the
thunderbolt) by, 153 ; size
of an atom, 166.

Varavara 60.

Vardhamana 232.

Vasubandhu xxvi, xxvii.

Va'sudeva xi, lix, xvi.

Va'taya'yana xlii, 30.

Vidya'bhūshana, Satia-
chandra, (S. C.) xxvii.
Vijayanagara xlix.
Vijaya'nabhiksha 60, 81, 95,
113, 119, 122.
Vikramaditya xlii, xlv, xlix.
Vrinda lxxix.
Vya'di lix, xcv.
Vya'sa or Vedarvya'sa xxiv.

W

Waddell xxxv, xxxviii,
Waite 44, 47.
Weber xlvii, lxxxv.

Wema Kadiphees xi.
Wenzel xxii.
Whitney xc.
Wilson xxxv.
Wonpeke xciii.

Y

Yajña-Srī-Sa'takarni xxiii.
Yasodhara lvi, lvii, xciv.
Yoga'cha'rya xxxvii.

Z

Zeller 41.



INDEX OF SUBJECTS

A

Acids, mineral,	lxvii, 24
Adri	ii
Æthiop's mineral	6
Ahan'ka'sa, Ra'jasic,	70
Ta'masic,	70
Air, weight of,	223
A'ka'sa, aspect of,	88
the original	88
the derivative	89
A'ka'sa-atom	102, 104
Alchemy, Indian, origin of,	lxviii
Alchemical Tantras, Buddhist	i
Alkali, caustic, method of preparing,	42
Alum	10
Analysis and Synthesis, chemical—Elements and compounds	114
Añjana	11
Antimony	56
Anus (vide Param'sus)	
Aphiya'n	lxix
Ap-substances, simple and compound,	128
Aqua Regia	29
Arakpraka'n	lxxi
Arrak, essence, Persian,	lxvii
Aśta'mgah'vidya	ii
Atharva-vedas	lxix
Atomic theory of the Buddhists	177
of the Jaiuas	178

Atomic combination, theory of, ...	186
Atomic characters, change of, (Pitṛapa'ka or Pitṛarapa'ka) ...	191
Atoms, (Parama'ṇus), genesis of, according to Viṣṇu Pura'ṇa, ...	90
according to Para'sara, ...	97-98
according to certain school of Veda'ntists, ...	99
linking of, ...	190
arrangement of, in space, ...	211
physical arrangement of, ...	212

B

Bauddha-sarvasva ...	xxvi
Bauddha-Sataka ...	xxix
Bauddha system ...	61
Bha'vapraka'sa ...	lxxviii, lxxix
Bha'ta'di, units of, ...	111-113
Bha'ta-Parama'ṇus, genesis and structure of, ...	91-96
order of genesis of, according to Patan'jali, ...	102
Bha'tas, genesis of, according to Viś'vāna-bhikṣu,	101
cosmo-genesis of, ...	103-104
examples of different, ...	106-108
physical characters of, ...	126
mechanical mixture of the maṇa', ...	126
Borax ...	11
Bṛass ...	11
Buddha-charita ...	xxiv, xxxviii

C

Calamine ...	2, 17, 22
Calomel ...	16, 24
Cat's eye ...	34
Causal series ...	82

Causation, doctrine of,	72
Sāṅkhya view of,	72
Pātanjala-Sāṅkhya view of,	73
chain of,	76
Chandrika	lxxi
Chapala	3, 14
Chārmaka	24
Charvāka-siddhānta	xvii
Chārvāka system	61
Chemical action and heat	205
Chemical analysis and synthesis – Elements and compounds	114
Chemical combination	192
Chemical compounds, preparation of,	131
Chemical compositions and decompositions	136
Chemical theory of Nyāya-Vaiśeṣika	185
Chemistry in the medical schools of ancient India	124
Chemistry in Dhātukriyā or Dhātumañjari (Rudrayāmala Tantra)	24
in Dhāturathamālikā	23
in Kākaśaṇḍoṣvara-mata Tantra	12
in Rasachintā'mani of Madanāntadeva	18
in Rasahriḍāya of Bhikṣu Govinda	9
in Rasakalpa (Rudrayāmala Tantra)	19
in Rasanākṣatramālikā of Mathana śiṃha, physician to the king of Malwa	22
in Rasapradīpa	23
in Rasaprakāśa-sodha'kāra of Yaśodhara	16
in Rasara'jalekṣhami of Viśvaṇḍeva	22
in Rasaratna'kāra of Na'ga'rjuna	1
in Rasaratna'kāra of Nityaśāṭha	193
in Rasendraśekh'ra-da'mani of Somadeva	14

in Savarnatantra or Svamatantra	...	28
Chemistry of colours	+++	151-164
Chemistry of digestion	...	142-150
Chinese Buddhism	...	xxxiv
Chobehini	...	lxxvii
Chūlika'	...	11
(-lavana)	...	21
Cinnabar	...	20
factitious (Makaradhvaja)	...	23, 25, 27
Colour-potential, unit of,	...	93
Copper, extraction of,	...	4, 11, 20, 25
Copper pyrites, essence of,	...	22
Corundum	...	34
Cosmo-genesis, a bird's eye view of,	...	104-105
Cupel	...	11

D

Darada, essence of,	...	4, 11
Derī'ra'stra	...	lvii
Dharasis (invocations)	...	xxx, xxxi
Dhātukriya'	...	lxxx
Dhāturatsamā'la'	...	lxxiv
Diamond	...	34
hardness of,	...	35
faces of,	...	39
phosphorescence of,	...	40
Dichroism	...	37
Divyasesendras'ra	...	xvii
Dulva (by Csoma)	...	ix

E

Electrum	...	lxxxvi
Energy, transformation of	...	70-71

Index of Subjects

xi

potential form of,	72
liberation of,	74
modes of,	77
dissipation, of,	83
Evolution, beginning of,	64
formula of,	65
order of cosmic,	67
ditto according to the Vya'sa-bha'shya ...	69, 83
of matter (Ta'nma'trika arishtā) ...	84

F

Fusion mixture	13
-----------------------	----

G

Gairika	11
Gandhakakalpa (a Tantra)	xxxiii
Garbha-yantrem	6
Garuda	93
Garuda-pura'na, the,	xv, 31, 32
Gema, dissolution of,	5
fusion of,	10
knowledge of,	36
fusibility (liquefaction) of,	38
Gita'govinda	xxix
Glass	34
Gold	11, 20
augmented,	27
unaffected by fire,	52
Goraksha-sambhita '	xvii
Gunas (Reals)	61
acts of,	62, 70, 71
want of ubiquity of,	113

H

Harita's (orpiment)	25
Hetero-Bhautic 'quasi-compounds'	199
Hinaya's School	xxiii
Hinaya'sists	xiii, xxix
Hindus (ancient), mechanical, physical and chemical theories of,	69
Hira'kasa	21
Hiraka'si'sa	21

I

Iatro-chemical period	lxi
Iron, killed,	14, 20

J

Jaina system	61
Jalpaka'patsu	155
Jas-Ja (or zinc) (<i>vide yasa</i>)	lxxiv
Ja'stra	24

K

Kabbalists, the,	44
Kajjali	6
Ka'sachandi'syara	lix
Kakshaputa Tantram	6
Ka'masu'tra	xiii, 30
Ka'mya (bell-metal)	lxxxix
Ka'myaka	25
Ka'kushta	fi
Ka'nta	li
Karpurasa	16
Kasha (= $\frac{1}{2}$ pala)	52

Index of Subjects

xiii

Ka'sisa (proper )	...	...	21
(pushpa )	...	...	21
Ka'siana (vitriola )	...	...	21
Kharpara	...	...	lxiv, 24
Khechara (mica )	...	...	11
Kira'tas	...	...	...lxviii, lxxxiv
king of,	...	...	12
Koshthi' apparatus, the,	...	...	iv, 8, 16
Kubjika'mata	...	...	xlii

L

Laghva'ryabhatti'yam	...	...	xc
Lalitavistara	...	...	xxxi
Lead	...	...	11, 20, 25

M

Ma'dhyamika, a system of Philosophy,...	ii, xv, xxxvii
Maha'bha'rata	lxxxiv
Maha'bhūtas	170
constitution of,	171
Maha'casas, the,	70
Mahat, the intelligible essence of Cosmos	67, 68, 70
Maha'vagga	xxxiii
Maha'ya'na School	xxxiii
Maha'ya'nism, origin and development of &c.,	ii, xii, xxviii
Maha'ya'nists	xii, xxi
Makaradhraja, preparation of,	55
analysis of,	57 (note)
Ma'kshika	11
Matter, general properties of,	179
Mdo (by Csoma)	xxxvii
Measures of weight and capacity	103-106
Medical authorities, succession of,	130

Mercury, fixation of,	5
killed,	19, 20
tests for,	23
Metals, (base), transmutation of,	2
(noble),	11
their loss in weight after calcination,	61
identification of—by their colouration of flames,	67
Mica	11
liquefaction of,	13, 20, 25
Milk—Bi-Bhautic quasi-compounds	202
Minerals, crystalline character of,	39
Mlechchha	lxxxii
Mono-Bhautic compounds	192-198
Mono-Bhautic Earth-substance	127

N

Neo-Platonists, doctrines of the,	xxvi, 44
Neo-Pythagoreans, the,	44
Nidānasamgraha	lxxviii
Nirālajana	54
Nyāya-Vaiśeṣika, views of,	109
chemical theory of,	186

O

Oils—Bi-Bhautic quasi-compounds	202
Opium	lxviii, lxxxii
Organic compounds	138
Orpiment	20, 25

P

Pa'la dynasty	xlvi
Pañchasiddhāntika'	xi

Pañcābhikaraṇa (quintuplication)...	170, 176
Paramānu; cosmo-genesis of,	103-104
definition of,	118
magnitude of,	167
mixture of,	119
Parchment, Leyden,	lxxxi
Pa'ñma'adalya	167
Parina'ma—Evolutionary Process	173
Parina'ma-Vā'da versus A'rambha-Vā'da	155-158
Parispaṇḍa—Resolution of all physical action into	
motion	216
Phiraṅgaroga	lxxvii, lxxix, lxxxii, 24
Phiraṅgas	lxxx
Pittala	25
Portuguese	lxxvi
Potentials, order of genesis of, according to	
Patañjali,	160-161
Prajñāpāramitā	xxxii, xl, li, 5
Prakṛiti	60, 69, 70
Precious stones	35
Process for the fabrication of gold—Homakṛiṇa'	18
Pañcāśiddhānta	xc
Podgalas (Matter), specific characters of,	179
Purnsha	64
Pyrhonism	xv

Q

Qualities, of compounds	129
sensible,	180
change of—under the influence of heat (Pa'ka-	
jotpatti)	190
Quaternion	172

R

Rājanighanta...	...	...	35
Rajas, (Energy),	...	...	61
action of,...	...	...	62
activity due to,	...	...	63
Rājataranginī	...	...	xi, xxi
Rājivarta ...	...	...	20
Rasachandrodaya	...	...	xvii
Rasahargana	...	...	xvii
Rasadīpa	...	...	xvii
Rasadīpikā	...	...	xvii
Rasahridaya	...	xliv, li, lviii, lxxvii, lxxxiv,	58
Rasaka	...	...	li, lv, 20, 24
Rasakalpa	...	...	lviii
Rasakāśāli'	...	...	xvii
Rasakarpūra	...	...	lxiv
Rasakashdya Vaidyaka	...	...	xvii
Rasakamudi	...	...	lxxviii
Rasakutuka	...	...	xvii
Rasamaṅgala or Rasamaṅgala	...	...	lxii, lxxiv
Rasamañjarī'	...	...	lxvi, lxxvii
Rasamrita	...	...	lxxiv
Rasakshatama'ika'	...	...	li
Rasapradīpa	...	...	lxxvii, lxxviii
Rasaprakāśa-sudhā'kara	...	...	lv, xvii
Rasam'jalakshmi'	...	...	lix
Rasara'jamahodadhi	...	...	xvii
Rasara'jam-riga'ika	...	...	xvii
Rasarañjana	...	...	lxxvii
Rasārtaṇa	...	...	xvii
Rasaratna'kara	xxiii, xxxvii, xli, xlv, li, lxi, lxxvii,	...	xvii
Rasaratnapradīpa	...	...	xvii
Rasaratnasamucchaya	...	lii, liv, lxxiv, lxxviii, xlv	

division of mineral kingdom in, ...	135
date of, according to T. G. Kāla, ...	221
Rasaratnāvalī' ...	xvii
Rasārcava xlii, lii, liii, lix, lxii, lxv, lxix, lxxi, lxxii, 57	
notice of different colours of metallic flames in, ...	136
Rasa, the, ...	11, 20
Rasasāra ...	xliz, lxv
Rasaratvesvara ...	xvii
Rasavisvadarpana ...	xvii
Rasayogamuktāvalī' ...	xvii
Rasendrabhāskara ...	xvii
Rasendrachintāmani ...	lxxii, xov, 55
Rasendrachūdāmani ...	liv, lxii, 52, 54
Rasendrakalpādruma ...	lxxiii
Rasendramāṅgala ...	9
Rasendrasārasaṅgraha ...	lxxi
Raservaradursana ...	xviii
Raservara-siddhānta ...	xvii
Ratnākara ...	lxix
Ratnapari'kshā ...	30, 31
Ratnatraya ...	iii
Realgar ...	20, 25
Realu, collocation of, ...	65, 70, 71
Rock crystal ...	34
Romaka ...	11
Romakasiddhānta ...	xvi
Rosierucians, the, ...	44, 47
Ruby, test of, ...	34
Rudrayāmala Tantra ...	lxxx, 27
"Rules of squares" ...	40
Rupyaśhratī ...	34

S

Saddharmapundarika	...	...	xxxii
Saindhava	...	...	11
Sal-ammoniac	...	...	11, 21
Saṁkhadra'vaka or Saṁkhadra'vaka	...	lxvii, lxxi,	29
Sa'mudra	...	...	11
Saṁkhadra'varasa	...	...	24
Sa'ekhya-Pa'tanjala system	...	...	59, 60
conceived view of,	...	...	109, 120, 121
view of the earlier,	...	...	124
Sapphira	...	...	34, 37
Sarjika'kaba'ra	...	...	11
Sa'rṅadhara-saṁgraha	...	lxix, lxx, lxxxviii	
Savyaka	...	...	11, 20
Satva, (the essence ),	...	...	61
defined,	...	...	62
conscious manifestation due to,	...	...	63
Saṁa'shāri'	...	...	17
('alums')	...	...	21
Saṁvarchala	...	...	11
Sauri'cāḥjana	...	...	54
Siddhanta	...	...	xvi
Silver	...	...	4, 11, 20
killing of,	...	...	23
Size of atoms (see Paramāṇus, magnitude of,)			
Small-potential	...	...	95
Sound-potential, unit of,	...	...	92
Soups	...	...	202
Space, as extension and position,	...	...	61
Śhūlabhāta	...	...	69, 70
Śhṛālekha	...	...	xxii
Śhṛaṇi'ti	...	...	40
Śhṛabha-bhāta	...	...	172

Sukkarati Vyôha	...	...	...	xxx
Sulphur	...	...	...	11, 20
Suramgama-Sûtra	...	...	...	xxi
Su'ryasiddha'nta	...	...	...	xc
Svarasaindu'ra, preparation of,	...	...	...	55
analysis of,	...	...	...	57 (note)
Syntaxis	...	...	...	xc
Syphilis	...	...	...	lxxvii

T

Tamas, (mass )	...	...	...	61
action of,	...	...	...	62
Stability due to,	...	...	...	63
Tanma'tra (Sa'kshabhûta ).	...	...	...	67, 69
(infra-atomic particle of subtle matter ),	...	...	...	78, 86
genesis and structure of, according to Vishwupura'ra	...	...	...	91-96
according to Para'sara	...	...	...	96
according to certain School of Veda'tists,	...	...	...	100, 120
Tâtric period, the,	...	...	...	1
Tantrists	...	...	...	44
Taste-potential	...	...	...	34
Tathâgata-guhyaka	...	...	...	xxxi
Tiksha	...	...	...	11
Timæus	...	...	...	lxxxvi
Time, infinite,	...	...	...	78
measures of,	...	...	...	158-163
Tin	...	...	...	11, 20
Touch-potential, unit of,	...	...	...	93
Trivrit-krama (triplication )	...	...	...	172
Tuttha (green vitriol )	...	...	...	25
Tuvarî (alum-earth )	...	...	...	17

U

Upasana	11, 20
U'rdhvapa'tana apparatus	...	...	16
Utala	...	...	167

V

Vakra'nta, essence of	4, 11
Vaipulya Sa'tras	...	...	xxxii
Vaishika-Nya'ya	...	...	59
Vartaloḥa	...	...	20
Va'tara'yana-bha'shya	...	...	210
Veda'nta	...	...	59
view of	...	...	168
Vida	...	...	10, 11
Vimala	...	...	11
Vitriol, blue,	...	...	10
green,	...	...	20
Vrihatsamhita'	...	...	lxxvii, 30
Vr̥ttaloḥa	...	...	lxxix
Vya'sa-bha'shya	...	...	59, 75

W

Weight of Air	223
---------------	-----	-----	-----

Y

Yasada	...	...	lxxii
Yasada'yaka	...	...	24
Yavaksha'ra	...	...	11
Yavanas	...	...	lxxiv
Yoga'sha'ra-bha'mi-sa'stra	...	...	xxvi
Yogaratas'kara	...	...	xxvi
Yogasudha'siddhi	...	...	xxvi

Z

Zinc	...	...	...	4
extraction of,	...	...	...	17, 19, 22
Zircon	...	...	...	34



